

ACADEMIC ELECTIVE



Learning Activity Sheets for Chemistry 1

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LEARNING ACTIVITY SHEET (LAS)

Lesson Exemplar	1	Date	
Lesson Title/Topic:	Chemistry in Daily Life		
Name		Grade & Section	

Activity No. 1: Everyday Chemistry

Instructions: Fill in the table with examples from daily life where chemistry is involved in health, environment, and industry. Use short phrases that show how chemistry is applied. After completing the table, briefly explain why each example fits its category. Be ready to share with the class so everyone can compare and discuss how chemistry connects to real life.

Category	Example	Explanation
Health		
Environment		
Industry		

Activity No. 2: Career Word Hunt

Instructions: Complete the word puzzle on chemistry-related careers. After completing the puzzle, listen to the presentation of your teacher on each profession's roles or tasks and chemical processes involved. Write down each profession and its roles or tasks in the table below. Share your notes with a seatmate to explain how these careers contribute to health, environment, and industry.

L D G J G B P O L Y M E R C H E M I S T Z T H T H V C P J M
I O H U F O R E N S I C C H E M I S T W C N Q O J X T E Z U
Y P H L H V R K K U P R D V A I O K V P P W J G J Z L K I N
J H V F L B I V T Z E G D Z F D K Q U E G A Z U K J V B R T
U A C T E Y Z D W N T Y Z X O C O Y Z U Z U O J B M R G J D
Y R C S A K I Y Q I R D R V D R O I L O G I Q K A H E G R H
N M T H V X P U C X O H G L A B Z S B P V I M T Q M U G B T
T A P E Y Z U A I C L A L C M S F X M M D T S C O J Z Z S V
J C O I J E V X V H E S N R V B M A F E V I B F O A X I N Y
T I L U X O M K A E U Y R A N U B Y E J T I H O Z N M Q N U
C S C T J D X Y N M M M H A N P N U O N N I B R N E N C B D
F T N Q W S N T O I C I J G Q O C Y E B F Q C I H Q J Z P R
W O X S J R M T V C H Y U R K T T I K L O J R C A P R T Q C
X P R D I F Q B S A E Y C I K R C E D R E Q R N H R P U G K
Y S M S G O O I G L M V B C T S A O C A U E B D O E X Q U Z
T K T Y M O V P H E I V L U S O S G G H T E U A D W M N G I
P I X U L D Q M P N S Z D L I K X E D A N S Y G W K E I P T
G H Q O K T S W T G T G A T M O I I W M Q O W D B E L L S Z
Z T X J H E M W Z I C I Y U A V O B C R I W L A W Z P N H T
J E C C F C C N F N R L G R N K A V G O D D A O U T P X Y T
T X M D A H J T O E M V V A Z D T R Q K L N L P G G L V J D
H H Q L W N R H T E X L R L J L U K M V M O Z B M I O L U K
P A Z U N O P A N R H L B C T Y R E T C C Y G C D V S H C J
R O O V L L M M C W G H V H F V W Y W T F M D I M F W T H Q
W F H P I O Q T P V W M Z E R E T W Z Z T H X O S J M C O D
K Z E S C G X J G P O D W M O Z G Q W G S K B Q G T I F Y O
B Z X G B I C S O O B A V I W N B E V W E Q J B E P S D K U
H R I O X S E K N T B Z O S F C O K Q T J E F V Y A C B V U
T M K C R T Q L Y R N Q I T K S S F F I Z M T M M L U S I J
V U U Z O G F N C L I N I C A L C H E M I S T L H L B C T Y

Profession	Roles or Task	Chemistry Connection

Activity No. 3: Career Match

Instructions: Match each product, service, or task with the chemistry-related profession most directly responsible for it. Then explain the chemistry involved in each correct match.

- | A | B |
|------------------------------------|-----------------------------|
| 1. drug formulation | a. chemical engineer |
| 2. fuel processing | b. biochemist |
| 3. nutrient analysis | c. forensic chemist |
| 4. ceramics and polymers | d. material scientist |
| 5. pesticide management | e. agricultural chemist |
| 6. water quality testing | f. environmental chemist |
| 7. crime scene drug analysis | g. electrochemist |
| 8. shampoo and lotion formulation | h. pharmaceutical scientist |
| 9. battery electrolyte development | i. food scientist |
| 10. enzyme-based diagnostics | j. cosmetic chemist |

Chemistry Careers	Product / Service / Task	Explanation

Activity No. 4: True or False

Instructions: Evaluate the statements on chemistry, applications, and careers. Mark each as true or false, then justify your reasoning to your peers.

1. Forensic scientists use chemical tests to identify crime scene substances, as done in the PNP Crime Lab and the NBI.
2. Chemical engineers only work in labs, not in industries like oil, cement, or food production.
3. Pharmaceutical scientists need knowledge of chemical-biological interactions to create medicines for diseases like dengue and TB.
4. Materials scientists only study natural materials like bamboo or stone, ignoring synthetics.
5. Environmental chemists test air, water, and soil to track pollution in rivers and lakes, then design cleanup methods.
6. Food chemists analyze flavors, preservatives, and nutrients to ensure safe and appealing products for consumers.
7. Petrochemical scientists only study gasoline, ignoring plastics, fertilizers, and other petroleum-based products.
8. Cosmetic chemists apply knowledge of chemical stability and skin compatibility when designing lotions, shampoos, and makeup.
9. Agricultural chemists test soil nutrients and fertilizers to improve crop yield and sustainability.
10. Polymer scientists investigate synthetic materials like nylon and Kevlar, which are used in clothing, ropes, and protective gear.

No.	Answer	Explanation
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

LEARNING ACTIVITY SHEET (LAS)

Lesson Exemplar	2	Date	
Lesson Title/Topic:	Physical and Chemical Properties of Matter		
Name		Grade & Section	

Activity No. 1: Mini Demonstration

Materials: piece of chalk, crayon, copper wire, antacid tablet (e.g., Alka-Seltzer), small piece of paper, matches or lighter, balance (optional), thermometer (optional), clear beaker or cup, water, stopwatch, safety goggles, tongs.

Safety: Put on safety goggles, gloves, mask, and lab gown; work in a ventilated area; use tongs for burning; have water or extinguisher ready.

Procedures:

1. Set up and label your workspace. Lay out materials and measuring tools. Put on safety goggles and gloves. Work in a ventilated area for burning and reactions.
2. Record baseline data for each sample. Appearance (color, texture), mass (if using a balance), temperature, and state (solid/liquid). Write these in your notebook.
3. Perform the change and observe.
 - a. **Break chalk:** Hold chalk and snap it with hands; collect any dust. Time the action and reweigh if possible. Record appearance of fragments and dust.
 - b. **Melt crayon:** Warm the crayon tip gently until it softens and then melts into liquid wax on a tray. Let it cool and solidify again. Record time to melt, temperature if available, and color.
 - c. **Bend copper wire:** Use pliers to bend the wire into a new shape. Note any surface changes, sound, or cracking. Reweigh if possible.
 - d. **Fizz antacid tablet:** Drop the tablet into a clear cup of room-temperature water. Observe bubbling, temperature change, and residue. Time how long fizzing lasts.
 - e. **Burn paper** (teacher demonstration only): Hold the paper with tongs and ignite it briefly in an appropriately ventilated area; allow it to char or form ash, then extinguish it safely. Record flame color, smoke production, ash, and mass before/after if possible. Do not intentionally smell smoke or combustion products.
4. Record detailed observations immediately. For each change note: color change, gas produced (e.g., visible bubbling), temperature change, new solid or liquid formed, mass change, reversibility, and any other safe observable evidence.
5. Decide classification and identify property. Use your observations to decide physical or chemical and name the property demonstrated (see next section

for guidance). Write a one-sentence justification citing at least two pieces of evidence (e.g., “bubbles formed and mass decreased; therefore chemical — gas produced and new substances formed”).

Data and Results:

Test	Type of Change	Property demonstrated	Type of Property	Evidence to justify
Chalk broken				
Crayon melted				
Copper wire bent				
Antacid fizzing				
Paper burning				

Synthesis:

1. What overall patterns did you notice when comparing physical changes with chemical changes?

2. Which pieces of evidence were most convincing in deciding whether a change was physical or chemical, and why?

3. How does understanding physical and chemical properties help explain and solve problems in daily life?

Activity No. 2: Substance Evidence Comparison

Materials: candle wax (paraffin), whole milk (fresh), granulated sugar (sucrose), white vinegar (4% acetic acid), metal spoon, heat source (electric hotplate, stove, or alcohol lamp), lighter or match sticks, baking soda, small beaker or cup, stirring rod, paper towels, tongs, metal tray

Safety: Put on safety goggles, gloves, mask, and lab gown; work in a ventilated area; use tongs for burning; have water or extinguisher ready.

Procedure A: Candle Wax

1. Place a candle on a metal tray.
2. Note color and hardness.
3. Use the lighter or matchstick to ignite the candle.
4. Observe flame color, smoke, melting pool.
5. Extinguish the flame.
6. Drop a small piece of wax into a clear glass of water.
7. Let the mixture sit for a few minutes.
8. Record observations in a table.

Procedure B: Milk

1. Warm ~50 mL milk a little.
2. Add 1 tsp vinegar, stir, and wait 1–2 minutes.
3. Add 10 mL of milk to 100 mL of water in a clear glass and stir.
4. Let the mixture sit for a few minutes.
5. Record observations in a table.

Procedure C: Sugar

1. Put 2 tbsp sugar in a small pan.
2. Note its color and texture.
3. Heat gently while stirring until it melts and turns light brown.
4. Remove from heat.
5. Add sugar to 100 mL of water and stir. (Try dissolving in cold vs warm water)
6. Let the mixture sit for a few minutes.
7. Record observations in a table.

Procedure D: Vinegar with baking soda

1. Put 1 tsp baking soda in a glass.
2. Add 2–3 tbsp vinegar, watch fizz.
3. Add 10 mL of vinegar to 100 mL of water in a clear glass and stir.
4. Let the mixture sit for a few minutes.
5. Record observations in a table.

Data and Results:

Material	Physical properties	Chemical properties (observed in test)	Short explanation
Candle wax (paraffin)			
Milk (whole)			
Sugar (sucrose)			
Vinegar (4% acetic acid)			

Synthesis:

1. Why can't substances like candle wax, milk, sugar, or vinegar be defined only by their appearance, and how did testing reveal properties that appearance could not show?

--

2. How did observing both physical changes and chemical changes help you understand the true identity of each substance?

--

3. How does testing both physical and chemical properties ensure accurate identification of substances in science and everyday life?

--

LEARNING ACTIVITY SHEET (LAS)

Lesson Exemplar	3	Date	
Lesson Title/Topic:	Accuracy and Precision		
Name		Grade & Section	

Activity No. 1: Measure It (Part 1)

Instructions: Measure the mass of a wooden block five times using a triple beam balance. Record each value in grams in the table below. Use the digital balance reading from a calibrated instrument as the accepted reference value. Calculate the average mass, percentage error, and standard deviation. Interpret your results based on these calculations.

Data and Results:

Trial	Mass (g)	$x_i - \bar{x}$	$(x_i - \bar{x})^2$
1			
2			
3			
4			
5			
Σ			

Computations:

Average:

Percent error:

Standard deviation:

Interpretations:

Activity No. 2: Measure It (Part 2)

Instructions: Imagine you are a materials engineer testing a rock for construction. Measure its volume five times using water displacement and express the final volume in cm^3 . Record your data, then calculate the average, percentage error, and standard deviation. The reference value will be provided by your teacher. As in industry, accuracy and consistency decide approval.

Data and Results:

Trial	Initial Volume of Water (mL)	Final Volume of Water (mL)	Volume of the rock (cm^3)	$x_i - \bar{x}$	$(x_i - \bar{x})^2$
1					
2					
3					
4					
5					
Σ					

Computations:

Average:

Percent error:

Standard deviation:

--

Interpretations:

--

Synthesis:

1. How does repeating trials improve reliability?

--

2. Why is error analysis critical in industry?

--

3. What would high variability mean for industry decisions?

--

Activity No. 3: Accurate or Precise

Instructions: Analyze the distance a ball rolls five times for each scenario. Classify each data set as accurate, precise, both, or neither. Show your complete solution in a separate sheet of paper. Justify your choice in one sentence using evidence from the values. Finally compare your reasoning with a peer to discuss which evidence best supports your classification.

	Distance, True Value = 10 m			
Trial	Set A (m)	Set B (m)	Set C (m)	Set D (m)
1	8.0	15.0	9.9	12.0
2	12.0	6.0	10.1	12.1
3	10.0	13.0	10.0	11.9
4	11.0	5.0	10.0	12.0
5	9.0	14.0	10.1	12.1

Computations:**Set A:**

Trial	x_i Distance (m)	$x_i - \bar{x}$	$(x_i - \bar{x})^2$
1	8.0		
2	12.0		
3	10.0		
4	11.0		
5	9.0		
Σ			
% error			
standard deviation			

Interpretation:

--

Set B:

Trial	x_i Distance (m)	$x_i - \bar{x}$	$(x_i - \bar{x})^2$
1	15.0		
2	6.0		
3	13.0		
4	5.0		
5	14.0		
Σ			
% error			
standard deviation			

Interpretation:

--

Set C:

Trial	x_i Distance (m)	$x_i - \bar{x}$	$(x_i - \bar{x})^2$
1	9.9		
2	10.1		
3	10.0		
4	10.0		
5	10.1		
Σ			
% error			
standard deviation			

Interpretation:

--

Set D:

Trial	x_i Distance (m)	$x_i - \bar{x}$	$(x_i - \bar{x})^2$
1	12.0		
2	12.1		
3	11.9		
4	12.0		
5	12.1		
Σ			
% error			
standard deviation			

Interpretation:

--

LEARNING ACTIVITY SHEET (LAS)

Lesson Exemplar	4	Date	
Lesson Title/Topic:	Types and Sources of Error		
Name		Grade & Section	

Error Gallery Work

Error Station Cards

Station 1 – Miscalibrated Balance: A digital balance consistently reads 0.5 g higher than the actual mass.

Station 2 – Timing Variability: Students use manual stopwatches to measure reaction time, but recorded values vary widely.

Station 3 – Thermometer Placement: A thermometer touches the container wall while heating, giving inaccurate readings.

Station 4 – Parallax Error: A burette reading is taken at an angle, leading to inconsistent volume measurements.

Station 5 – Contaminated Sample: A beaker used for a new solution was not rinsed properly, affecting the results.

Student Worksheet:

Station	Type of Error (Systematic/Random)	Source of Error	Corrective Measure	Redesign Proposal (sketch/describe)
1				
2				
3				
4				
5				

Error Simulation Activity

Error Station Cards

Station 1 – Miscalibrated Scale

- Imagine weighing fruit at a grocery store, and the scale always adds 0.5g.
- Record the observed weight vs. the expected weight.
- Discuss why this is a **systematic error** and how recalibration fixes it.

Station 2 – Stopwatch Variations

- Two classmates timed a sprint race using different stopwatches.
- Compare the slightly different times recorded.
- Identify this as a **random error** and propose using automated timing devices.

Station 3 – Thermometer Reading

- Observe a thermometer or graduated cylinder from above, then at eye level. Notice the difference caused by **parallax error**.
- Practice reading the meniscus at eye level to reduce human error.
- Relate to everyday life: measuring water in a cup when cooking.

Student Worksheet:

Station	Error Type	Source of Error	Corrective Measure	Redesign Proposal (sketch/describe)
1				
2				
3				

Case Study Analysis Activity**Case Study Station Cards****Station 1 – Laboratory Balance**

- Case Study: A laboratory balance consistently shows 0.5 g heavier than the actual mass.
- Context: Imagine weighing fruit at a grocery store, and the scale always adds extra weight.
- Error Type: **Systematic Error – Instrument Source**
- Corrective Measure: Recalibrate the balance before use.

Station 2 – Timing a Reaction

- Case Study: Two students time the same chemical reaction but get slightly different results.
- Context: Everyday example: two friends time a sprint race with their phones and get slightly different times.
- Error Type: **Random Error – Observer Source**
- Corrective Measure: Use automated timing devices or repeat trials to average results.

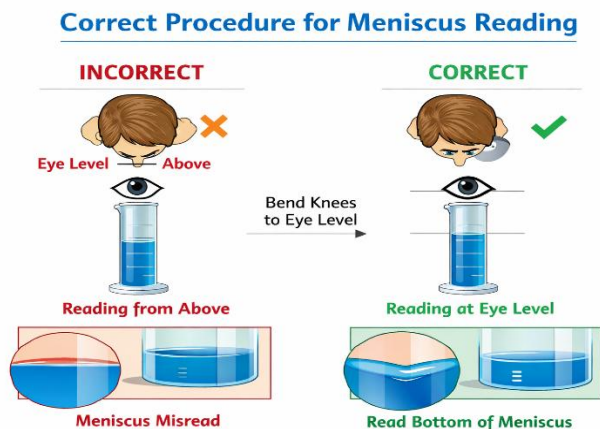
Station 3 – Reading a Graduated Cylinder

- Case Study: A student misreads the liquid level in a graduated cylinder by looking from above.
- Context: Everyday example: misreading the water level in a measuring cup when baking.
- Error Type: **Human Error – Observer Source (Parallax)**
- Corrective Measure: Always read at eye level with the meniscus.
- Skill Integration: Teacher demonstrates correct meniscus reading using a thermometer or cylinder. Students practice aligning their eyes with the meniscus to avoid parallax errors.

Student Worksheet:

Detective Puzzle – Error Simulation Activity

Skill Integration: Case 3 emphasizes meniscus reading. The teacher demonstrates correct technique; students practice eye-level alignment, compare incorrect vs. correct readings, and conclude how proper technique reduces human error.



Source: https://www.clrn.org/how-to-read-a-meniscus-chemistry/?utm_source=copilot.com

Student Worksheet:

Case	Error Type (Systematic/Ra ndom)	Source (Instrumental/Environmental/Observational /Personal)	Corrective Measure	Redesign Proposal
1				
2				
3				

Mystery Scenarios

Case 1 – Misread Thermometer A thermometer consistently reads 2 °C higher than the actual temperature.

- Error Type: Systematic
- Source: Instrumental
- Corrective Measure: Recalibrate thermometer.

Case 2 – Faulty Ruler A ruler has worn markings, leading to inconsistent length measurements.

- Error Type: Systematic
- Source: Instrumental
- Corrective Measure: Replace or recalibrate the ruler.

Case 3 – Inconsistent Timing Two students time the same reaction but record slightly different results.

- Error Type: Random
- Source: Observer
- Corrective Measure: Use automated timing devices or average repeated trials.

Case 4 – Graduated Cylinder Reading A student reads the liquid level from above instead of eye level.

- Error Type: Human (Parallax)
- Source: Observational
- Corrective Measure: Read at eye level with the meniscus.

Lab Setup Detective – Activity

Student Task

- In groups, inspect the station carefully.
- Identify errors as **systematic/random** or by source (**instrumental, environmental, observational, personal**).
- Propose corrective measures (e.g., recalibrate, level surfaces, read thermometer at eye level with the meniscus).
- Present findings to the class.
- Teacher emphasizes: *“Errors are everywhere — today we learned how to classify them and reduce their impact in experiments.”*

Inspect the Station

1. Students examine the mock lab setup for intentional flaws.

- Check the **balance** for calibration issues
- Observe the **beaker** placement on the surface
- Look at the **thermometer** angle

2. Classify the Errors

Identify each flaw as systematic or random, or by source type.

- Label as **instrumental, environmental, observational, or personal**
- Distinguish between **systematic vs. random** patterns

3. Propose Corrective Measures

Suggest practical solutions to minimize error impact.

- Recalibrate the balance
- Level the surface for the beaker
- Read thermometer at **eye level** with the meniscus

4. Present and Reflect

Groups share findings and connect to reliability in experiments.

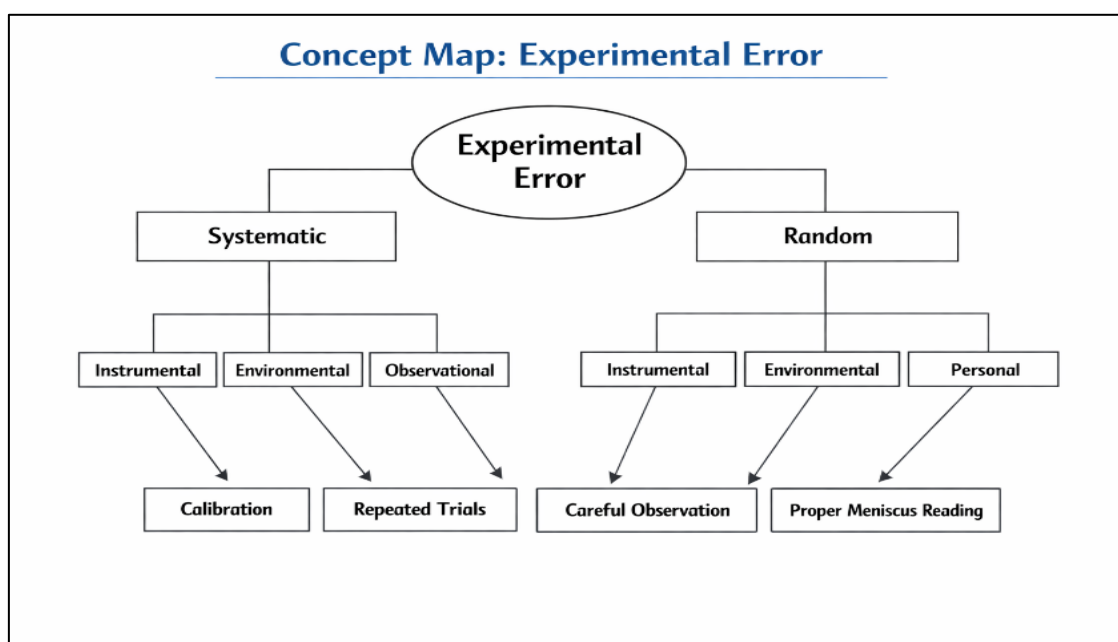
- Present classification and solutions
- Reflect on how errors affect accuracy and precision

Student Worksheet:

Error Observed	Error Type (Systematic/Random)	Source of Error (Instrumental, Environmental, Observational, Personal)	Corrective Measure	Safety Notes
Example: Balance not calibrated	Systematic	Instrumental	Recalibrate before use	Ensure balance is on a stable, flat surface

Lab Safety Measures

- Always wear **lab goggles, gloves, and a lab coat** when inspecting equipment.
- Keep the **workspace dry and uncluttered** to avoid slips or spills.
- Handle balances, beakers, and thermometers **carefully and with clean hands** to prevent contamination or damage.
- Do not consume food or drinks near the lab station.
- Ensure **electrical cords and surfaces are stable** before use.
- Read instruments (like thermometers or balances) at **eye level** to avoid parallax errors and misinterpretation.
- Report any broken or malfunctioning equipment to the teacher immediately.
- Practice **honesty and precision** in recording observations—never alter or falsify data.
- Work **collaboratively but responsibly**, ensuring all group members follow safety rules.
- Wash hands thoroughly after the activity.
- Respect teammates and follow the teacher's instructions.
- No running, pushing, or rough play during relay tasks



Debate Scoring Rubric:

Criteria	Excellent (3)	Satisfactory (2)	Needs Improvement (1)
Content Accuracy & Relevance	Arguments are accurate, well-supported with evidence, and directly address the topic	Arguments mostly accurate, some evidence used, generally relevant	Arguments lack accuracy, weak or no evidence, off-topic
Organization & Clarity	Ideas are logically structured, transitions smooth, and points easy to follow	Some organizations, occasional lapses in clarity, points somewhat connected	Disorganized, unclear, difficult to follow
Delivery & Engagement	Confident delivery, clear voice, persuasive tone, maintains audience attention	Adequate delivery, voice clear but less engaging, some persuasive elements	Weak delivery, unclear voice, little engagement
Team Collaboration	Team members contribute equally, coordinate well, and support each other	Uneven participation, some coordination, limited support	Minimal participation, poor coordination, lack of teamwork
Critical Thinking & Rebuttal	Strong rebuttals, anticipates counterarguments, demonstrates deep analysis	Some rebuttals, limited anticipation of counterarguments, moderate analysis	Weak or no rebuttals, little analysis, ignores counterarguments
Values Integration (Honesty, Respect, Responsibility)	Demonstrates respect for opponents, honest use of evidence, and responsible argumentation	Generally respectful, evidence mostly honest, some responsibility shown	Disrespectful, dishonest evidence use, irresponsible argumentation

Rubric for the Activity:

Criteria	Excellent (3)	Satisfactory (2)	Needs Improvement (1)
Definition & Distinction	Clear and correct	Partially correct	Inaccurate/missing
Identification of Source	Accurate and specific	Partially correct	Vague/incorrect
Corrective Measure	Practical and feasible	Partially effective	Irrelevant/vague
Redesign Proposal	Clear, logical, minimizes error	Partially effective	Unclear/ineffective
Collaboration	Active, cooperative, respectful	Uneven participation	Minimal/disruptive

LEARNING ACTIVITY SHEET (LAS)

Lesson Exemplar	5	Date	
Lesson Title/Topic:	Measurement and Laboratory Skills: Scientific Notation and Significant Figures		
Name		Grade & Section	

Activating Prior Knowledge: Option 1 (Do you remember?)

Here's your visual aid, *Significant Figures Ladder* (Source: <https://shorturl.at/afm3S>). It organizes the rules step-by-step, from the simplest (very small numbers, leading zeros) up to more complex cases (trailing zeros with decimals, embedded zeros, non-zero digits). This ladder design helps students recall the rules in sequence and connect them with examples. You can use it as a classroom poster for quick reference, a handout alongside practice problems, or a review tool before assessments.

Presenting Examples: Option 1: Conversion Relay Game

Practice in Relay Teams (Game Phase)

Teams solve posted conversion tasks in relay format, applying the SOP rules.

- First student solves the first conversion and writes the answer with correct sig figs
- Pass the baton to the next teammate for the next task
- Continue until all problems are solved
- Fastest team with accurate answers wins

Student Worksheet:

Task	Solution Steps	Final Answer (Scientific Notation + Sig Figs)
1500 mL → L	...	...
3.2×10^3 g → kg	...	...
0.00045 L → mL	...	...

Reflection: Answer individually after the activity.

1. How did you ensure honesty and precision in reporting values?

→ _____

2. What skill will you apply next time when handling laboratory measurements?

→ _____

Sig Fig Quick-Fire Challenge

Instructions: Divide the class into two teams. Teacher flashes a measurement on the board. Teams have **10 seconds** to:

- Write the number of significant figures.
- Give a one-line justification.
- Correct answer = 1 point; clear justification = bonus point.
- Play for **5 rounds**; the highest score wins.

Sample Rounds

- 25.0 °C → 3 sig figs
- 0.0042 s → 2 sig figs
- 1.5×10^3 mL → 2 sig figs (or 4 if written as 1.500×10^3)
- 3.20×10^3 g → 3 sig figs
- 100.0 g → 4 sig figs

Reflection Prompt

- Why do zeros sometimes count and sometimes not?
- How does applying significant figures ensure accuracy in lab reporting?

Number Mystery Challenge:

Instructions: The teacher writes two “mystery numbers” on the board: 0.00000045 L and 450,000,000 g). Ask students: “How easy is it to read and work with these numbers in the lab?” Challenge them to rewrite each number in scientific notation.

Example: 0.00000045 L → 4.5×10^{-7} L

450,000,000 g → 4.5×10^8 g

Have students identify the significant figures in each rewritten number. Teams shout out their answers and award points for correct notation and sig fig identification. Bonus points for clear reasoning.

Game Rounds

Round 1: 0.00000045 L	Expected Answer: 4.5×10^{-7} L (2 sig figs)
Round 2: 450,000,000 g	Expected Answer: 4.5×10^8 g (2 sig figs)
Round 3: 0.0042 s	Expected Answer: 4.2×10^{-3} s (2 sig figs)
Round 4: 25.0 °C	Expected Answer: 2.50×10^1 °C (3 sig figs)
Round 5: 100.0 g	Expected Answer: 1.000×10^2 g (4 sig figs)

Reflection Prompt

1. Why is scientific notation more efficient than writing out long numbers?
2. How do significant figures ensure accuracy in laboratory reporting?

Finding Practical Application

Food Chemist Lab

Objective: Practice measuring, calculating, and reporting concentration using significant figures, scientific notation, and unit conversions.

Part A – Measurement

1. Measure the mass of sugar using a digital balance.
 - Record: _____ g
2. Measure the volume of water using a graduated cylinder.
 - Record: _____ mL

Part B – Calculation

1. Convert volume to liters.
 - Show work: _____
2. Calculate concentration:
 - Answer: _____ g/L

Part C – Apply Rules

1. Report answer with correct **significant figures**.
 - Answer: _____
2. Express the result in **scientific notation**.
 - Answer: _____
3. Convert g/L → kg/L.
 - Answer: _____

Part D – Reflection

- Why do significant figures matter in reporting laboratory data?
- How does scientific notation make values easier to read?
- Why must food scientists rely on accurate measurements?

Environmental Sampling Activity

Instructions:

1. Using a graduated cylinder, collect a water sample (e.g., 1500 mL).
2. Convert the volume into liters and express it in scientific notation.
 - Example: 1500 mL → 1.5×10^0 L (2 sig figs).
3. Using a digital balance, weigh contaminants filtered from the sample (e.g., 3.20×10^3 g).
4. Calculate concentration = contaminant mass ÷ water volume.
5. Apply significant figure rules to report the concentration.
6. Express the final result in scientific notation and perform a unit of conversion (e.g., g/L → kg/L).
7. Discuss how precise measurements affect environmental decisions, such as pollution limits and safety standards.

Example Output

Volume = 1500 mL = 1.5×10^0 L (2 sig figs)

Mass = 3.20×10^3 g (3 sig figs)

Concentration = $(3.20 \times 10^3 \text{ g}) / 1.5 \text{ L} = 2.1 \times 10^3 \text{ g/L}$ (3 sig figs)

Converted to kg/L = 2.1 kg/L

Generalization

Lab to Life Activity

Procedural Guide – Oral Rehydration Solution (ORS) Activity

Step 1 – Preparation

- Wear gloves, goggles, and a lab coat.
- Gather materials: digital balance, graduated cylinder, clean beaker, salt, sugar, and distilled water.

Step 2 – Measurement

- Measure the mass of salt and sugar using the digital balance.
- Measure the volume of water using the graduated cylinder.
- Record all values with correct units and note the number of significant figures based on instrument precision.

Step 3 – Calculation

- Compute concentration: $\text{Concentration} = \frac{\text{Mass of solute}}{\text{Volume of solvent}}$
- Apply **significant figure rules** to ensure accuracy.
- Express results in **scientific notation**.
- Convert units if required (e.g., grams to milligrams, liters to milliliters).

Step 4 – Application

- Compare your calculated values with standard ORS formulation guidelines.
- Discuss how precision ensures **safe dosage for patients** and **accurate labeling for distribution**.

Step 5 – Reflection

- Write a short explanation: *“How does precision in measurement protect community health and build trust in product labeling?”*

General Rubric – Significant Figures & Scientific Notation Activities

Criteria	Excellent (3)	Satisfactory (2)	Needs Improvement (1)
Evidence Use	Reflection cites clear, specific evidence from measurements, calculations, or activity results to support claims	Reflection mentions evidence but lacks detail or clarity	Reflection provides opinions without evidence or connection to activity
Reasoning Quality	Explains logically how evidence supports conclusions about real-world outcomes (e.g., safety, costing, compliance)	Provides some reasoning but connections to outcomes are partial or vague	Little or no reasoning; outcomes stated without explanation
Real-World Relevance	Strongly connects lab precision to SHS exits (entrepreneurship, TESDA skills, health practices) with clear examples	Mentions relevance but examples are general or incomplete	No clear link to real-world outcomes or SHS exits
Values Integration	Reflection demonstrates honesty, responsibility, and precision in discussing outcomes	Reflection shows some values but inconsistently	Values not evident in reflection
Clarity & Depth	Reflection is well-structured, concise, and insightful	Reflection is understandable but lacks depth	Reflection is unclear, superficial, or incomplete

Criteria	Excellent (3)	Satisfactory (2)	Needs Improvement (1)
Accuracy of Measurement & Sig Figs	Measurements recorded correctly with proper units and sig fig rules consistently applied	Measurements mostly correct, minor sig fig errors	Measurements inaccurate or sig fig rules ignored
Use of Scientific Notation & Conversions	Values correctly expressed in scientific notation and unit conversions accurate	Values expressed in scientific notation but with minor errors in format or conversion	Values not expressed in scientific notation or conversions incorrect
Reasoning & Explanation	Clear explanation of how results were obtained, reasoning linked to context (entrepreneurship, SOPs, health)	Partial explanation of reasoning, some link to context	Minimal or no explanation, answers given without reasoning
Application to SHS Exit Context	Strong connection made to chosen track (costing/labeling, SOP compliance, health safety), showing relevance	Some connection made to track, relevance partially explained	Little or no connection to track, relevance is unclear
Values Integration (Honesty, Responsibility, Precision)	Demonstrates honesty in reporting, responsibility in handling data, and precision in calculations	Shows some values but inconsistently	Values not evident in work or reflection

Lab Safety Measures

- Always wear **lab goggles, gloves, and a lab coat** when inspecting equipment.
- Keep the **workspace dry and uncluttered** to avoid slips or spills.
- Handle balances, beakers, and thermometers **carefully and with clean hands** to prevent contamination or damage.
- Do not consume food or drinks near the lab station.
- Ensure **electrical cords and surfaces are stable** before use.
- Read instruments (like thermometers or balances) at **eye level** to avoid parallax errors and misinterpretation.
- Report any broken or malfunctioning equipment to the teacher immediately.
- Practice **honesty and precision** in recording observations—never alter or falsify data.
- Work **collaboratively but responsibly**, ensuring all group members follow safety rules.
- Wash hands thoroughly after the activity.
- Respect teammates and follow the teacher's instructions.
- No running, pushing, or rough play during relay tasks

Debate Scoring Rubric:

Criteria	Excellent (3)	Satisfactory (2)	Needs Improvement (1)
Content Accuracy & Relevance	Arguments are accurate, well-supported with evidence, and directly address the topic	Arguments mostly accurate, some evidence used, generally relevant	Arguments lack accuracy, weak or no evidence, off topic
Organization & Clarity	Ideas are logically structured, transitions smooth, and points easy to follow	Some organizations, occasional lapses in clarity, points somewhat connected	Disorganized, unclear, difficult to follow
Delivery & Engagement	Confident delivery, clear voice, persuasive tone, maintains audience attention	Adequate delivery, voice clear but less engaging, some persuasive elements	Weak delivery, unclear voice, little engagement
Team Collaboration	Team members contribute equally, coordinate well, and support each other	Uneven participation, some coordination, limited support	Minimal participation, poor coordination, lack of teamwork

Criteria	Excellent (3)	Satisfactory (2)	Needs Improvement (1)
Critical Thinking & Rebuttal	Strong rebuttals, anticipates counterarguments, demonstrates deep analysis	Some rebuttals, limited anticipation of counterarguments, moderate analysis	Weak or no rebuttals, little analysis, ignores counterarguments
Values Integration (Honesty, Respect, Responsibility)	Demonstrates respect for opponents, honest use of evidence, and responsible argumentation	Generally respectful, evidence mostly honest, some responsibility shown	Disrespectful, dishonest evidence use, irresponsible argumentation

Rubric for the Activity:

Criteria	Excellent (3)	Satisfactory (2)	Needs Improvement (1)
Definition & Distinction	Clear and correct	Partially correct	Inaccurate/missing
Identification of Source	Accurate and specific	Partially correct	Vague/incorrect
Corrective Measure	Practical and feasible	Partially effective	Irrelevant/vague
Redesign Proposal	Clear, logical, minimizes error	Partially effective	Unclear/ineffective
Collaboration	Active, cooperative, respectful	Uneven participation	Minimal/disruptive

LEARNING ACTIVITY SHEET (LAS)

Lesson Exemplar No.	6	Date	
Lesson Title/Topic:	Planck's Quantum Hypothesis; Bohr's Model of the Atom and Quantized Energy Levels; Schrodinger's Wave Mechanical Model; Orbitals and Probability-Based Electron Distribution; Comparison of Bohr's Model and the Quantum Mechanical Model; and Simple Applications of Quantized Energy in Spectra and Technology		
Name		Grade & Section	

Activity No. 1: Connect-the-Dots Atomic Journey

Objective

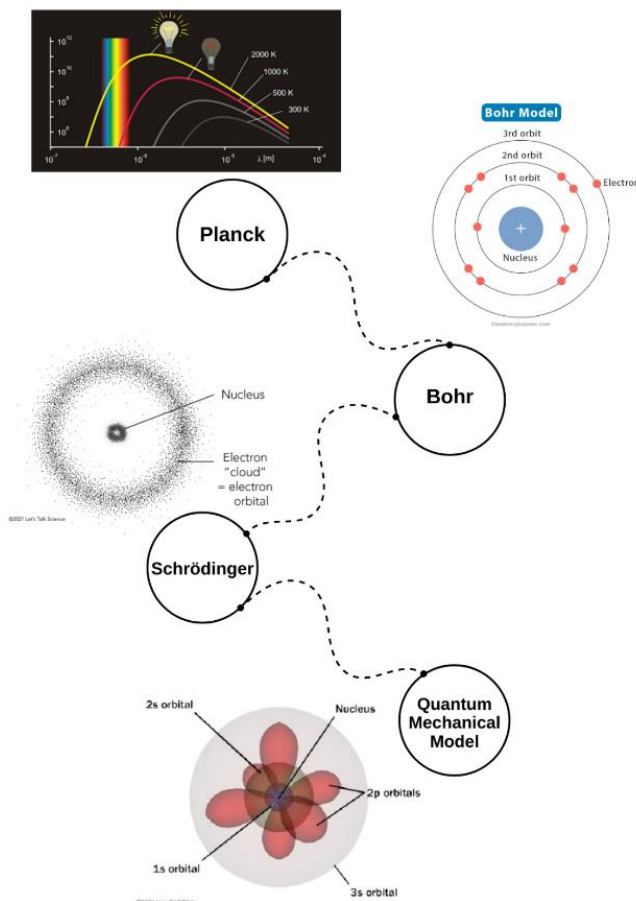
Explore how Planck, Bohr, and Schrödinger contributed to the development of quantum theory, leading to the Quantum Mechanical Model.

Materials Needed

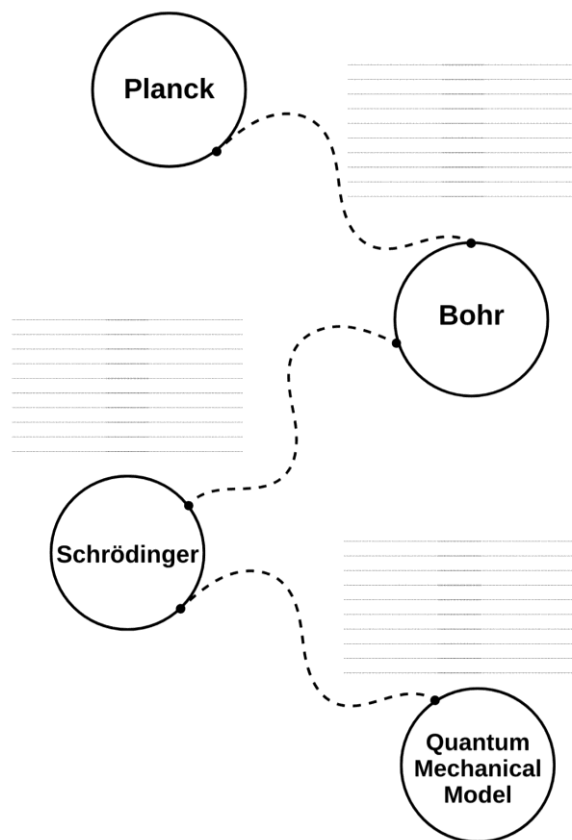
- Printed or projected Connect-the-Dots diagram (Planck's blackbody radiation, Bohr's orbit model, Schrödinger's electron cloud, Quantum Mechanical orbitals)
- Writing materials

Instructions

- Look at the diagram showing **Planck** → **Bohr** → **Schrödinger** → **Quantum Mechanical Model**.



2. Connect the dots in sequence (1 → 2 → 3 → 4).
3. Write your own short prediction: *“What changes in our understanding of electrons might occur as we move from dot 1 to dot 4?”*



Guide Questions

1. What was Planck's main idea about energy?

2. How did Bohr apply quantized energy to electrons?

3. How did Schrödinger change the view of electron movement?

4. How does the Quantum Mechanical Model describe electrons today?

Synthesis

“How does connecting the contributions of Planck, Bohr, and Schrödinger help us understand the modern Quantum Mechanical Model of the atom?”

Activity No. 2 - Learning Stations: Contributions to Quantum Theory

Objective:

Understand the contributions of Max Planck, Niels Bohr, and Erwin Schrödinger to the development of quantum theory, and explain how their ideas are advanced atomic models.

Station 1 – Max Planck (Laboratory Technician Assignment)

Task Title: Flame Test and Quantized Energy Observation

Materials: Small samples of salts (NaCl, KCl, CuSO₄, CaCl₂), Metal loop or clean wire, Bunsen burner or alcohol lamp, Safety goggles and gloves, Technical Log

Procedure:

1. Prepare labeled salt samples on heat-resistant trays.
2. Dip the metal loop into one salt sample.
3. Hold the loop in the flame and observe the color produced.
4. Record the flame color and corresponding element in the Technical Log.
5. Repeat for each salt sample.
6. Discuss how the emitted colors relate to quantized energy release.

Safety Protocol:

Only the teacher or supervised learners handle flames. Tie back long hair, wear goggles, and keep flammable materials away.

Data Recording:

Salt Sample	Flame Color	Inferred Element	Energy Concept

Station 2 – Niels Bohr (Optoelectronic Engineer Assignment)

Task Title: LED Spectrum and Energy Level Comparison

Materials: LED lights of different colors (red, green, blue, white), Power source or battery pack, Diffraction grating or prism (optional), Technical Log Sheet

Procedure:

1. Connect each LED to the power source.
2. Observe and compare the colors emitted.
3. Use a prism or grating to view the light spectrum if available.
4. Record wavelength ranges and relate them to energy transitions.
5. Discuss how Bohr's model explains discrete energy levels.

Data Recording:

LED Color	Approx. Wavelength (nm)	Energy ($E = h\nu$)	Interpretation

Station 3 – Erwin Schrödinger (Design Specialist Assignment)

Task Title: Orbital Model Construction

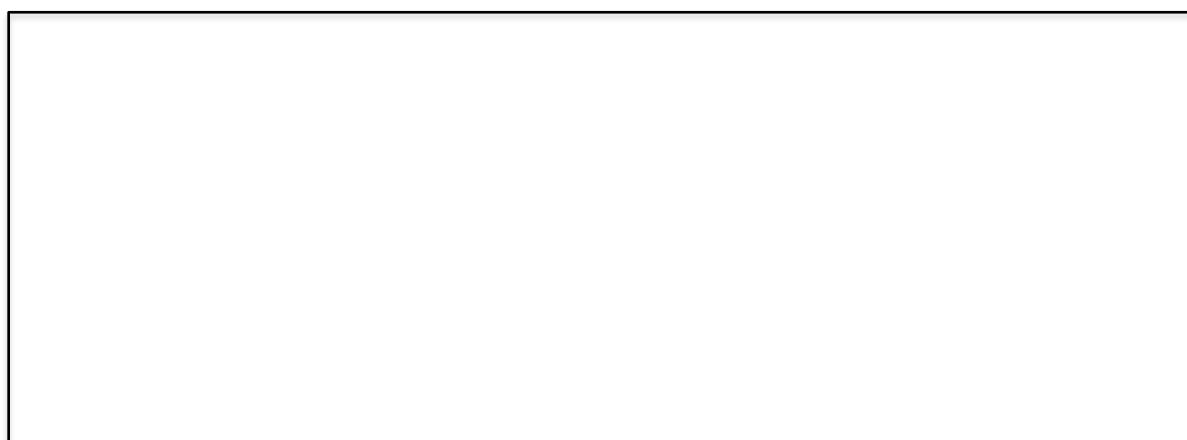
Materials: Balloons or colored clay, Toothpicks or sticks, Cardboard base, Labels and markers

Procedure:

1. Form spherical shapes for S orbitals and dumbbell shapes for P orbitals using clay or balloons.
2. Mount them on a cardboard base to represent spatial orientation.
3. Label each orbital and nucleus clearly.
4. Discuss how the model represents probable electron locations rather than fixed paths.

Output:

Draw or describe your 3D orbital model here:



Guide Questions:

1. How did Planck's idea of quantized energy change our view of atoms?

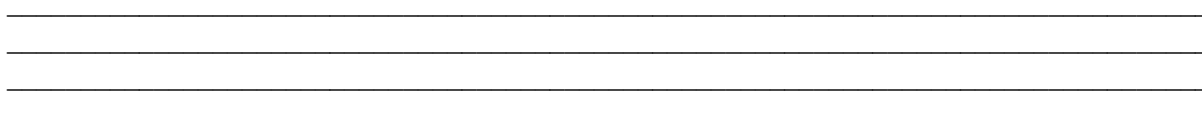
2. How did Bohr explain electron movement differently from Rutherford?

3. How did Schrödinger's model improve Bohr's fixed orbits?

4. Why is the Quantum Mechanical Model considering the most accurate today?

Synthesis

How do the contributions of Planck, Bohr, and Schrödinger show the importance of building past discoveries to improve scientific understanding?



Rubrics for Grading:

Criterion	Excellent (25 pts)	Proficient (20 pts)	Developing (15 pts)	Beginning (10 pts)
1. Task Execution and Procedure Compliance	Performs all steps systematically, adheres strictly to safety and procedural standards; demonstrates precision and initiative.	Completes most steps correctly; minor lapses in safety or sequence.	Attempts procedure with partial accuracy; needs guidance to maintain safety or order.	Performs task with frequent errors or unsafe practices; lacks procedural understanding.
2. Data Recording and Documentation Quality	Records data accurately using professional formats (tables, units, labels); includes clear observations and interpretations.	Data mostly accurate; minor formatting or labeling issues.	Data incomplete or inconsistently recorded; lacks clarity in interpretation.	Minimal or incorrect data; poor documentation format.
3. Conceptual Understanding and Analysis	Demonstrates deep understanding of quantum concepts; connects results to Planck, Bohr, or Schrödinger's theories with clear reasoning.	Shows good understanding; explains results with minor conceptual gaps.	Basic understanding; explanation lacks linkage to quantum principles.	Misinterprets or fails to connect findings to theoretical concepts.
4. Professionalism and Technical Communication	Uses formal, precise language; report follows Technical Work Order format with clear sections (Objective, Procedure, Safety, Data, Reflection).	Report mostly professional; minor lapses in tone or structure.	Report partially professional; inconsistent formatting or tone.	Informal or incomplete report; lacks technical structure.

LEARNING ACTIVITY SHEET (LAS)

Lesson Exemplar	7	Date	
Lesson Title/Topic:	Quantum mechanical principles of electron arrangement; Aufbau principle; Pauli Exclusion Principle; Hund's Rule; electron configuration; orbital diagrams		
Name		Grade & Section	

Activity No 1: K-W-L Chart — *Understanding Atoms and Electron Arrangements*

Objective:

To explore what you already know, what you want to learn, and what you discover about atomic models and electron configurations.

Materials:

- Printed or digital K-W-L chart template
- Atomic model visuals (Dalton, Thomson, Rutherford, Bohr, Quantum Mechanical)
- Writing materials

Instructions:

1. Look at the chart below.
2. Fill in the **K (What I Know)** column with ideas you already know about atoms and how electrons are arranged.
3. Fill in the **W (What I Want to Know)** column with questions or things you are curious about atomic models and electron configurations.
4. After the lesson, complete the **L (What I Learned)** column with new knowledge and insights.
5. Share your chart with your group and connect your answers to how each atomic model improved upon the last.

K-W-L Chart

K – What I Know	W – What I Want to Know	L – What I Learned
Example: Atoms are made of protons, neutrons, and electrons.	Example: How do electrons fill orbitals?	Example: Each atomic model explains new discoveries about electrons.

Guide Questions

1. What do I already know about atoms and electrons?

2. What questions do I have about how electrons are arranged?

3. How did each atomic model (Dalton, Thomson, Rutherford, Bohr, Quantum Mechanical) add new ideas?

4. Which model best explains electron behavior?

5. How do electron arrangements affect the properties of elements?

Activity No. 2: Atomic Model Gallery Walk

Objective:

To trace the historical development of atomic models and explain how each one corrected or built upon the previous model.

Materials:

- Large printed images of Dalton, Thomson, Rutherford, Bohr, and Quantum Mechanical models
- Station guide questions (posted at each model)
- Individual answer sheets (this activity sheet)
- Writing materials

Instructions

1. Move with your group to your assigned station.
2. Study the atomic model displayed and read the guide questions posted.
3. **Individually** write your answers on this sheet — each student must complete his or her own output.
4. Rotate to the next station until you have visited all models.
5. After rotations, your group will prepare a short **2–3 minute presentation**, but your individual sheet will be submitted as your personal work.
6. At the end, contribute one key improvement from your assigned model to the **Model Evolution Timeline** created by the class.

Guide Questions per Station

Station	Guide Questions	Answer
Dalton	What was Dalton's main idea about atoms?	
	How did this model set the stage for later discoveries?	

Station	Guide Questions	Answer
Thomson	<p>What new particle did Thomson identify?</p> <p>How did this change the view of the atom?</p>	
Rutherford	<p>What did Rutherford's experiment reveal about atomic structure?</p> <p>What part of Thomson's model did it challenge?</p>	
Bohr	<p>How did Bohr explain electron movement?</p> <p>What concept of energy levels did he introduce?</p>	
Quantum Mechanical Model	<p>How does this model describe electron behavior differently from Bohr's?</p> <p>Why is it considered more accurate?</p>	

Reflection:

1. What surprised you the most about the model?

2. Write the key improvements of your assigned model.

Synthesis:

How does the evolution of atomic models show the importance of building on past discoveries to improve scientific understanding?

Activity No. 3: Electron Configuration Challenge

Objective:

To analyze the electron configuration and orbital diagram of an element, apply quantum mechanical principles, and connect these to real-world STEM applications

Materials:

- Periodic table
- Writing materials
- Group discussion notes

Instructions

1. You are an Atomic Structure Analyst.
2. Work with your group to study your assigned element.
3. On the activity sheet, complete the following tasks:
 - Write the electron configuration of your element.
 - Draw the orbital diagram (boxes and arrows for orbitals and spins).
 - Identify and explain how the Aufbau Principle, Pauli Exclusion Principle, and Hund's Rule apply.
 - Connect your element's electron structure to a real-world STEM application.
4. Each student must submit their own completed sheet.
5. During group presentations, use your individual notes to contribute confidently.

Individual Output:

Assigned Element: _____

1. **Electron Configuration:** _____

2. **Orbital Diagram:** *(Draw boxes/arrows to represent orbitals and electron spins)*

3. **Quantum Mechanical Principles Applied:**

- Aufbau Principle → _____
- Pauli Exclusion Principle → _____
- Hund's Rule → _____

4. **STEM Application of My Element:**

Guide Questions

1. How does electron configuration explain the element's stability or reactivity?

2. Which principle was most important in filling the orbitals correctly?

3. How does the orbital diagram help visualize electron arrangement?

4. Why is this element useful in science, technology, or everyday life?

Synthesis

How do electron configurations and quantum principles help us understand why elements behave the way they do in real-world applications?

LEARNING ACTIVITY SHEET (LAS)

Lesson Exemplar	8	Date	
Lesson Title/Topic:	The Quantum Theory and Electronic Structure of Atoms		
Name		Grade & Section	

Activity No. 1 – Quantum Number Detective

Objective: Students will decode electron configuration to identify mysterious "suspect" elements from the periodic table.

Materials:

- Periodic Table
- One set of **Suspect Cards** per group
- One **Detective Log Worksheet** per student.
- OpenStax. Chemistry 2e. '6.3 Development of Quantum Theory.' Houston, TX: OpenStax, 2019. <https://openstax.org/books/chemistry-2e/pages/6-3-development-of-quantum-theory>

Procedure:

In the mathematical solution of the Schrodinger equation, three quantum numbers are obtained. These are the principal quantum number (n), the angular quantum number (ℓ), and the magnetic quantum number ($m\ell$). They describe the atomic orbitals. A fourth quantum number, the spin quantum number (ms), completes the description of the electrons in the atoms.

1. Divide the class into detective groups of 3 to 4 students.
2. Distribute Evidence: Give each group a set of Suspect Cards.
3. The Mission: Groups must work together to decode the electronic configuration on each card and reveal the element.

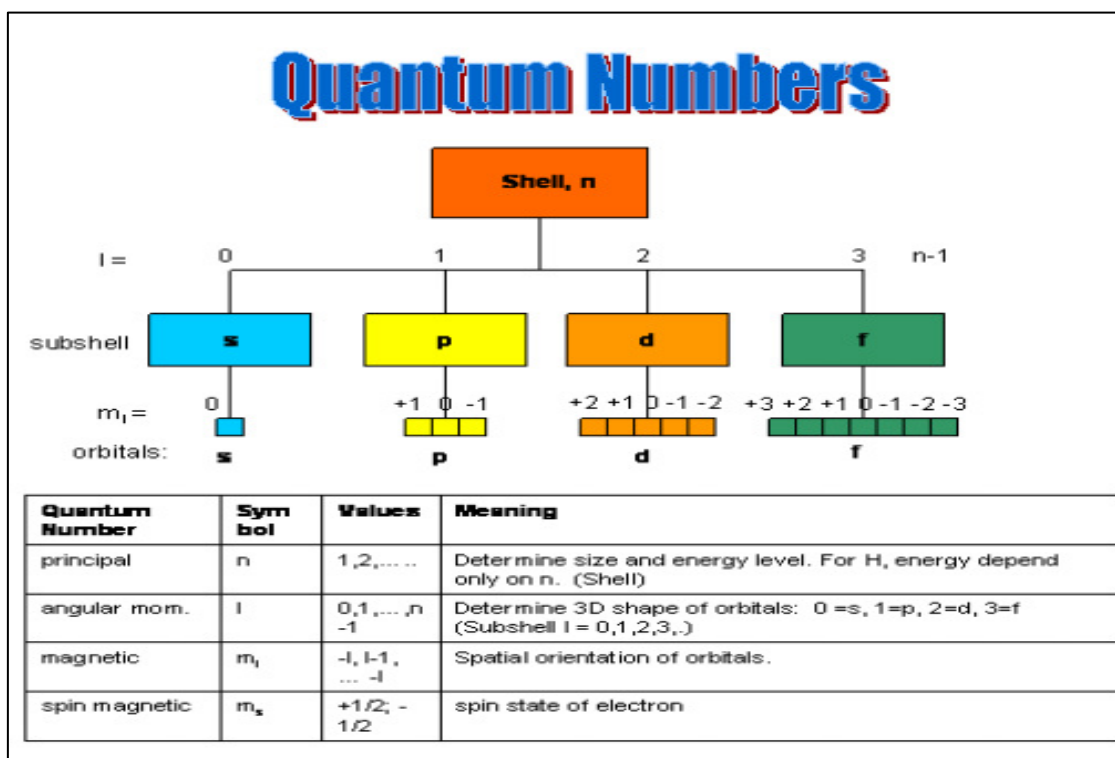
For each element:

- a. Using its electronic configuration, find the element's identity and write its set of quantum numbers using the Quantum Number Guide.
- b. Identify the last electron added.
- c. Fill in the table below.

Detective Log Worksheet

Suspect #	Electron Configuration	Atomic Number	Decoded Element Symbol	Last Electron	n	ℓ	$m\ell$	ms
Example	$1s^2 2s^2$	4	Be	$2s^2$	2	0	0	-1/2
1								
2								
3								
4								
5								

Quantum Number Guide



nuclearchem101.weebly.com

Guide Questions:

1. What principle determines the order of filling orbitals?

2. Why do electrons occupy separate orbitals first?

3. What is the highest occupied orbitals reached among the given elements?

4. How do quantum numbers provide a deeper explanation of electron configuration in atoms?

Activity 2 – Young Scientist at Work

Objective: At the end of the activity, learners will be able to apply their understanding of electron configuration to select and justify an appropriate element for a real-world application, identify its electron configuration, and describe its energy levels, sublevels, and orbitals.

Procedure:

Each learner will play as a junior scientist/engineer tasked to recommend an element for a real-world application using his or her knowledge of **electron configuration**.

1. Work with your group (5-6 members per group), choose one scenario below, and answer the given questions.
2. For 5 minutes, each group will present and discuss their chosen scenario.

Scenario (Choose ONE)

Scenario 1: Battery Designer

- You are designing a new battery for mobile devices.
- Choose an element that can easily lose electrons.

Scenario 2: Fireworks Chemist

- You are creating a fireworks display.
- Choose an element that produces a specific color of light.

Scenario 3: Electronics Engineer

- You are developing a computer chip.
- Choose an element that can control the flow of electricity (a semiconductor).

From your chosen scenario, you must:

1. identify the element;
2. write its electron configuration;
3. identify the main energy level, sublevel, and orbitals of the element; and
4. fill in the table below.

Scenario	Element	Electron Configuration	n	ℓ	mℓ	ms
1						
2						
3						

Guide Questions:

1. How do electron arrangements affect the behavior of atoms in chemical reactions?

2. Why is it important to understand orbitals?

3. How does understanding energy levels and orbitals help in real-life applications?

LEARNING ACTIVITY SHEET (LAS)

Lesson Exemplar	9	Date	
Lesson Title/Topic:	Development of the Periodic Table: Mendeleev's Arrangement, Pattern Recognition, and Prediction of Undiscovered Elements		
Name		Grade & Section	

Activity 1: Mystery Element

Students will be grouped and will be asked to analyze clues to identify elements predicted by Dmitri Mendeleev. Afterwards, the learners will present how these predictions were confirmed.

Materials Needed:

- “Clue cards” (properties of elements)
- Periodic table
- Worksheet or answer sheet

Procedure:

1. Explain that Mendeleev predicted elements by:
 - looking at patterns, leaving gaps, and describing unknown elements.

2. Investigation Phase

Each group will receive a mystery clue card describing a predicted element (without naming it).

The learners must:

1. identify the element;
2. match it with Mendeleev’s predicted name;
3. fill in the summary table; and
4. explain how the clues match the actual element.

3. Presentation: Each group will present:

- their “mystery element;
- the clues they used;
- how Mendeleev predicted it;
- their comparison: predicted vs actual.

Mendeleev Mystery Clue Cards

<p>Mystery Card 1</p> <ul style="list-style-type: none"> • Atomic mass ≈ 45 • Forms oxide X_2O_3 • Light metal • Located below boron <p><i>Identify the element and its Mendeleev predicted name.</i></p>	<p>Mystery Card 2</p> <ul style="list-style-type: none"> • Atomic mass $\approx 69-70$ • Low melting point metal • Forms oxide X_2O_3 • Located below aluminum <p><i>Identify the element and its Mendeleev predicted name.</i></p>
<p>Mystery Card 3</p> <ul style="list-style-type: none"> • Atomic mass $\approx 72-73$ • Semimetal/metalloid • Forms oxide XO_2 • Located below silicon <p><i>Identify the element and its Mendeleev predicted name.</i></p>	<p>Mystery Card 4</p> <ul style="list-style-type: none"> • Highly reactive metal • Forms +1 ions • Soft and silvery • Found in Group 1 <p><i>Identify the element and its Mendeleev predicted name.</i></p>

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<p>Mystery Card 5</p> <ul style="list-style-type: none"> • Noble gas • Very unreactive • Exists as a gas • Located in Group 18 <p><i>Identify the element and its Mendeleev predicted name.</i></p>	<p>Mystery Card 6</p> <ul style="list-style-type: none"> • Good conductor of electricity • Ductile metal • Forms +2 ions • Located in Group 2 <p><i>Identify the element and its Mendeleev predicted name.</i></p>
<p>Mystery Card 7</p> <ul style="list-style-type: none"> • Halogen • Very reactive nonmetal • Forms salts with metals • Located in Group 17 <p><i>Identify the element and its Mendeleev predicted name.</i></p>	<p>Mystery Card 8</p> <ul style="list-style-type: none"> • Transition metal • Variable oxidation states • Good catalyst • Located in the d-block <p><i>Identify the element and its Mendeleev predicted name.</i></p>

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Presentation Summary Table

Group	Mystery Element	Key Property Clues	Mendeleev's Prediction Method	Comparison: Predicted vs. Actual Properties
1	<i>e.g., Germanium (Ge)</i>	Atomic mass and repeating chemical-property clues consistent with eka-silicon.	Predicted as "Eka-silicon" based on periodic trends / group gaps.	Predicted: Mass ~72, dark gray metal. Actual: Mass 72.63, grayish-white metalloid.
2				Predicted: Actual:
3				Predicted: Actual:
4				Predicted: Actual:
5				Predicted: Actual:
6				Predicted: Actual:
7				Predicted: Actual:
8				Predicted: Actual:

Guide Questions:

1. What clues helped you identify the element?

2. How did patterns help in solving the mystery?

3. Why was Mendeleev's prediction important?

LEARNING ACTIVITY SHEET

Lesson Exemplar No.	10	Date	
Lesson Title/Topic:	Periodic Trends		
Name		Grade & Section	

Activity No. 1: From the Position to Trends Analysis

Objective: At the end of the activity, you should be able to:

- explain periodic trends by relating the position of elements in the periodic table to shielding effect and effective nuclear charge; and
- use these trends to compare and predict element properties.

Materials Needed:

LAS

Instructions: In groups of four, complete all parts of the activity, including the table, graphs, and guide questions. Use your knowledge of periodic trends such as period, group, shielding effect, and effective nuclear charge when answering.

Part I. Element Position

1. Complete the table.

Elements	Atomic Number	Electron Configuration	Valence Electron	Period	Family	Atomic radius (pm)	First Ionization Energy (kJ/mol)	Electronegativity (Pauling scale)	Electron Affinity
Li	3					152	520.2	1.0	59.6
B	5					85	800.6	2.0	26.7
O	8					73	1313.9	3.5	141
Na	11					186	495.8	0.9	52.8
K	19					227	418.8	0.82	48.4

1. Plot the given elements in the periodic table.

Periodic Table of the Elements																	
1	IA																VIIIA
2		IIA											IIIA	IVA	VA	VIA	VIIA
3																	
4																	
5																	

Figure 1. Blank Periodic Table

Source: Worksheets Library. "Periodic Table Template Worksheets Library." 2024. <https://worksheets.clipart-library.com/worksheet/blank-periodic-table-worksheet-29.html>.

Part II. Periodic Trends

A. Atomic Radius

- Using colored pens, graph the following in Figure A:
 - Red - Atomic number vs. Number of Valence Electron
 - Blue - Atomic number vs. Period
- In Figure B, plot the atomic number vs. Atomic radius.

Guide questions:

- Which elements belong to the same period? Family?
- Describe the pattern in the number of valence level electrons, and the electronic configuration of the elements in the same period and those at the same family.

Figure A. Atomic Number VS. Valence Electron and Period																				
8																				
7																				
6																				
5																				
4																				
3																				
2																				
1																				
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

Figure B. Atomic Number VS. Atomic Radius																				
250																				
200																				
150																				
100																				
50																				
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

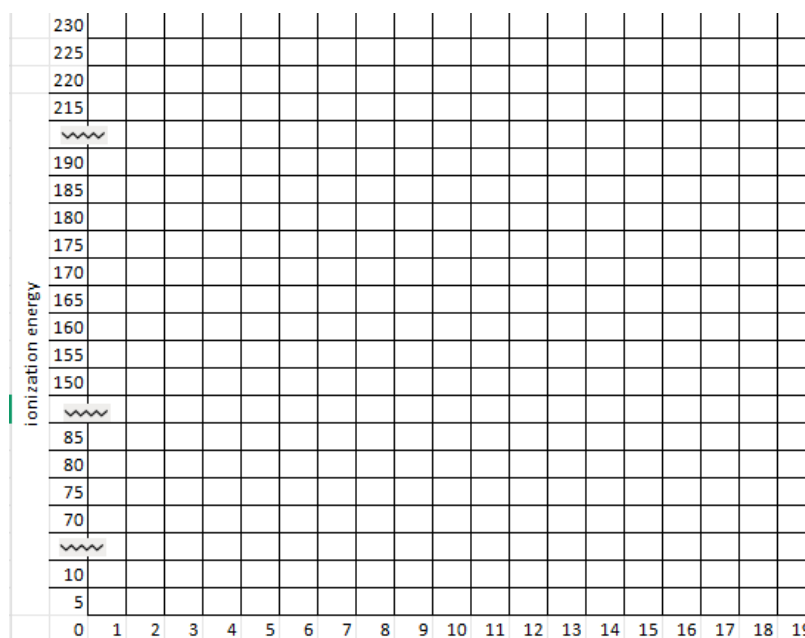
- How are these patterns related to the atomic radius?
- How does increasing effective nuclear charge across a period help explain the decrease in atomic radius and the increase in ionization energy?

B. First Ionization Energy

Graph the atomic number vs. the first ionization energy in the table

Guide questions/items:

- How do you describe the pattern in the first ionization energy for elements in the same period and those at the same family.
- Explain the pattern in first ionization energy for elements in the same period and those at the same family.
- How does increasing effective nuclear charge across a period help explain the decrease in atomic radius and the increase in ionization energy?
- Why does increased effective nuclear charge across a period tend to raise ionization energy even though the number of occupied energy levels stays the same?

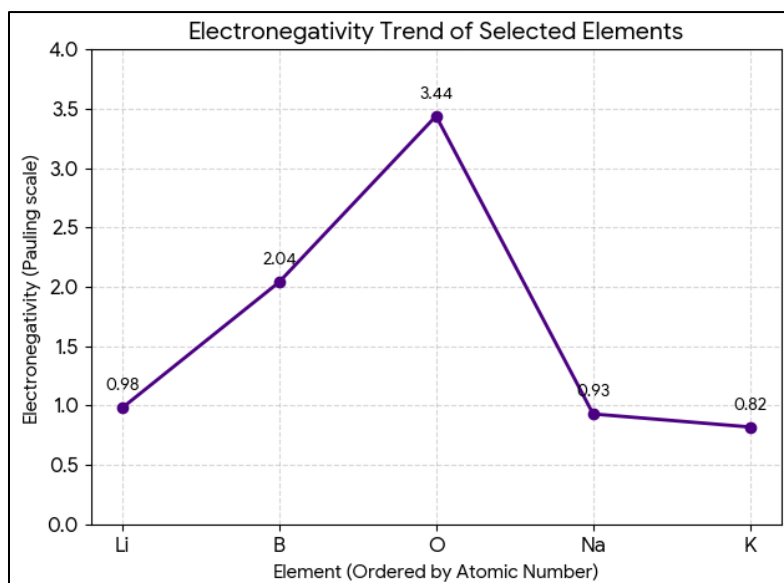


Electronegativity

Refer to the graph of elements vs. Electronegativity values to answer the guide questions.

Guide questions/items:

1. Describe the pattern in electronegativity for elements in the same period and those at the same family.
2. What trend for electronegativity can be drawn from the data and plots?
3. Explain the pattern in electronegativity for elements in the same period and those at the same family.

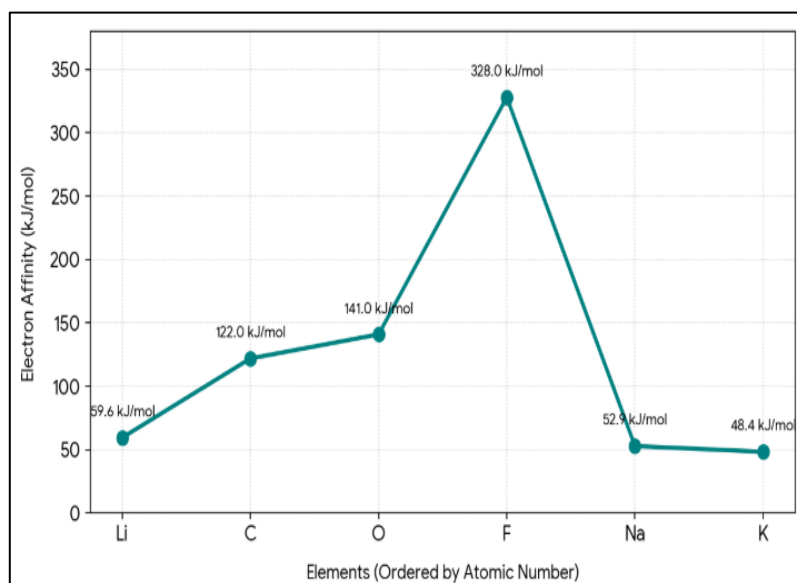


D. Electron Affinity

Refer to the graph of elements vs. Electron affinity values to answer the guide questions.

Guide questions/items:

1. Describe the pattern in electron affinity for elements in the same period and those at the same family.
2. What trend for electron affinity can be drawn from the data and plots?
3. Explain the pattern in electron affinity for elements in the same period and those at the same family.



Synthesis:

How does increasing effective nuclear charge across a period help explain the simultaneous decrease in atomic radius and increase in ionization energy?

LEARNING ACTIVITY SHEET (LAS)

Lesson Exemplar	11	Date	
Lesson Title/Topic:	Isotopes		
Name		Grade & Section	

Performance Task: Radioisotopes Around Us

Performance Standard: Learners will prepare clear and scientifically accurate information material that classifies selected radioisotopes as natural or human-made and explains their emission type, half-life, uses, and risks for a beginner audience.

G – Goal

Your goal is

1. to classify radioisotopes based on:
 - whether they are natural or man-made;
 - their type of radiation emission (alpha, beta, or gamma); and
 - their half-life.
2. explain how these properties affect their uses and risks.

R – Role

You are a science educator tasked with preparing an information sheet about radioactive isotopes

A – Audience

Your audience consists of senior high school science students who are learning about radioactivity for the first time.

S – Situation

There is confusion among students about:

- Which radioisotopes occur naturally and which are man-made
- What types of radiation they emit
- How to write the equation of the decay
- How half-life helps determine the amount of a radioisotope remaining.

Your material should clearly explain and organize this information.

P – Product / Performance

Create a 1–2 page information sheet about four radioisotopes. Then answer two short half-life computation items on a separate response sheet to demonstrate quantitative understanding.

1. Name of the radioisotope
2. Classification: Natural or Man-made
3. Type of emission: Alpha, Beta, or Gamma
4. Approximate half-life
5. One brief explanation of how half-life and emission type affect its use or risk

You must include:

- at least one natural radioisotope;
- at least one man-made radioisotope; and
- at least two different emission types.

This summative assessment will be evaluated using an analytic rubric aligned to the lesson objectives

Criteria	4	3	2	1
Scientific Accuracy of Radioisotope Classification	Radioisotope is correctly classified with no scientific errors.	Minor error in classification that does not affect overall understanding.	Several inaccuracies in classification showing partial understanding.	Classification is mostly incorrect or missing.
Correctness of Emission Type and Half-Life Information	Emission type(s) and half-life are completely accurate and clearly stated.	One minor factual error or incomplete detail.	Multiple errors or vague/incomplete information.	Emission type and/or half-life are incorrect or not provided.
Clarity of Explanation of Use or Risk	Explanation of use or risk is clear, accurate, and easy to understand.	Explanation is generally clear but lacks detail or depth.	Explanation is unclear or partially incorrect.	Explanation is confusing, inaccurate, or missing.
Completeness of Required Entries	All required information is present and fully addressed.	One required entry is incomplete.	Two or more required entries are incomplete or missing.	Most required entries are missing.
Quality of Organization and Formatting	Information is well-organized, neatly formatted, and easy to follow.	Organization is clear but formatting could be improved.	Organization is inconsistent or hard to follow.	Poor organization and formatting make the work difficult to understand.

LEARNING ACTIVITY SHEET

Lesson Exemplar No.	12	Date	
Lesson Title/Topic:	Isotopes and Radioisotopes: Applications in Medicine, Industry, and Environmental Science; Benefits, Risks, and Safe Use		
Name		Grade & Section	

Community Decision Case Study: Using Isotopes Responsibly

I. Objectives:

At the end of this performance task, students will be able to:

1. explain the benefits, risks, and safety considerations in the responsible use of isotopes; and
2. communicate the responsible and safe use of isotope technologies in real-life contexts.

II. Materials

LAS, printed case studies

III. Task

Scenario (Case Study)

Your local community is planning to adopt new technologies that involve the use of radioactive isotopes. Community leaders are consulting science students to help them understand how isotopes work, their benefits, and their risks before making decisions.

You are part of a Science Advisory Team assigned to review three real-world cases involving isotopes in different fields.

Case Studies

Case 1: Medical Center Expansion

A new hospital plans to use radioactive isotopes to diagnose heart disease and treat thyroid disorders.

Case 2: Infrastructure Safety Project

Engineers propose using radioactive sources to inspect bridges and pipelines without damaging them.

Case 3: Environmental Science Research Program

Researchers want to study ancient bones and wooden tools found near the community to understand local history.

Part A: Classification of Isotopes

For each case, identify and classify one isotope used.

Case	Field	Isotope	Application	Scientific reason
Case 1				
Case 2				
Case 3				

Part B. Benefits and Threats Analysis

Complete the extended table.

Case	Field	Isotope	Threats	Benefits	Safety Measure / Responsible Use
Case 1					
Case 2					
Case 3					

Answer the questions briefly:

1. Why are isotopes important to community development and scientific progress?
2. What safety measures should be followed to ensure isotopes are used responsibly?

IV. Synthesis

Name one isotope, its field of application, the scientific reason it is useful, and one safety consideration.

Rubrics for grading:

Criteria	4	3	2	1
Identification & Classification of Isotopes	Correctly identifies all isotopes and accurately classifies them into appropriate fields with complete details	Identifies most isotopes correctly with minor errors in classification	Some correct identifications but several errors in classification	Incorrect or missing identification and classification
Application & Scientific Explanation	Clearly explains applications and provides accurate, detailed scientific reasons for each isotope	Explains applications with generally correct scientific reasoning	Limited or partially correct explanations of application and reasoning	Explanations are unclear, incorrect, or missing
Benefits and Threats Analysis	Thoroughly analyzes both benefits and risks with clear, relevant examples for all cases	Adequate analysis of benefits and risks with some supporting details	Limited analysis; benefits or risks may be incomplete or unclear	Minimal or no analysis of benefits and risks
Safety Measures / Responsible Use	Provides realistic, detailed, and appropriate safety measures for each case	Provides appropriate safety measures with some detail	Safety measures are vague or lack relevance	Safety measures are missing or incorrect

LEARNING ACTIVITY SHEET (LAS)

Lesson Exemplar	13	Date	
Lesson Title/Topic:	Chemical Bonding and Compounds		
Name		Grade & Section	

Activity: Kitchen Chemistry Challenge

Procedure

1. Observe Household Substances
 - Examine salt, sugar, and water samples (real or pictured)
 - Record physical appearance (color, texture, state)
 - Note any immediate differences you notice
 - Discuss observations in your group
2. Test Solubility (Hands-On)

Add salt and sugar separately to water and observe.

 - Stir equal amounts of salt and sugar in separate cups of water
 - Record how quickly each dissolves
 - Compare the clarity of the solutions
3. Investigate Conductivity

Test electrical conductivity of salt solution vs sugar solution.

 - Use a simple conductivity tester or LED circuit
 - Test salt solution: does the bulb light?
 - Test sugar solution: does the bulb light?

Record results carefully
4. Classifying Bonding Type

Connect observations to bonding concepts

 - Salt (NaCl): ionic, electron transfer
 - Sugar (C₁₂H₂₂O₁₁): covalent, electron sharing
 - Water (H₂O): covalent, electron sharing
 - Explain why conductivity differs
5. Guiding Questions
 1. What happens when salt and sugar are added to water—do they behave in the same way?
 2. Which of these household substances do you think are ionic, and which are covalent? Why?
 3. How can properties like solubility and conductivity help us classify a substance as ionic or covalent?
6. Reflect and Question (Wrap Up)

Summarize findings and pose one guiding question.

 - Write 3 short sentences explaining differences
 - State which properties helped you classify substances
 - Pose one question you expect the lesson to answer

Activity: Property Based Classification

Lesson Focus: Examine how observable properties help classify substances as ionic or covalent.

Materials:

- Information cards (each with one substance: sucrose, sodium bicarbonate, polyethylene)
- Short property lists (solubility in water, electrical conductivity, physical form at room temperature)
- Chart paper or worksheet for group recording

Group Task

1. Observation
 - Read the information card for your assigned substance.
 - Highlight the listed properties (e.g., soluble in water, conducts electricity, solid at room temperature).
2. Classification
 - Decide whether the substance is **ionic** or **covalent**.
 - Identify which property (solubility, conductivity, or physical form) helped you make this classification.
3. Connection
 - Provide one **real-life example** of a similar substance (e.g., table sugar for sucrose, baking soda for sodium bicarbonate, plastic bag for polyethylene)
4. Explanation

Write **three short sentences** explaining your reasoning:

 - State the bonding type.
 - Describe the electron behavior (transfer vs sharing).
 - Link the property to the classification.

Guide Questions

5. Sharing
 - Present your group's classification and reasoning briefly to the class.
 - Listen to other groups and compare similarities or differences.

LEARNING ACTIVITY SHEET

Lesson Exemplar	14	Date	
Lesson Title/Topic:	Chemical Bonding and Compounds		
Name		Grade & Section	

Activity: Electron Story Cards

Lesson Focus: How do electrons form bonds, and how does this affect substance properties?

Materials:

Picture/story cards showing:

- An atom **giving electrons** to another atom (electron transfer)
- Atoms **sharing electrons** (electron sharing)

Group Task:

A. Observation

- Examine the cards carefully.
- Identify what is happening to the electrons on each card.

B. Classification

- Decide which card represents ionic bonding (electron transfer) and which represents covalent bonding (electron sharing).
- Record your choice on the worksheet.

C. Explanation

Write a short justification (2–3 sentences): State the bonding type.

- Describe the behavior of electrons.
- Link this to a property (e.g., solubility, conductivity, and molecular form).

D. Connection

Provide one real-life example of a substance with the same bonding type (e.g., NaCl for ionic, H₂O for covalent).

E. Guide Questions:

1. How does electron transfer differ from electron sharing?
2. Why do ionic compounds often conduct electricity in solutions, while covalent compounds usually do not?
3. How can these bonding ideas explain common substances like salt, sugar, and water?

F. Sharing

- Present your classification and reasoning.

Activity Sheet

Card Observed	Bonding Type	Electron Behavior	Property Linked	Real-Life Example	Justification (2–3 sentences)
Atom giving electrons					
Atoms sharing electrons					

Activity: Bonding Decision Task

Lesson Focus: How do ionic and covalent bonds explain the common behavior of substances?

Group Instructions

A. Form groups of 3–5 learners.

B. Each group will be given short real-life scenarios.

Scenarios for Classification

- Salt solution
- Sugar solution
- Liquid water
- Plastic material
- Potassium chloride fertilizer
- Ammonium nitrate fertilizer
- Carbon dioxide

C. For each scenario, discuss and decide:

1. Is the bonding reaction ionic or covalent?
2. Are electrons transferred or shared?
3. What is one resulting structure or observable property (e.g., ions in solution, neutral molecules, conductivity)?

D. Record your answers on the table below.

E. Guide Questions

1. How does electron transfer differ from electron sharing?
2. Why do ionic compounds often conduct electricity in solutions, while covalent compounds usually do not?
3. How can bonding ideas explain common substances like salt, sugar, water, plastic, and fertilizers?

F. Write a short justification (2–3 sentences) for each scenario.

G. Be ready to share your group's reasoning with the class.

Activity Sheet

Scenario	Bonding Type	Electron Behavior	Resulting Structure / Property	Justification (2–3 sentences)
Salt solution (NaCl dissolves in water)				
Sugar solution (sucrose dissolved in water)				
Liquid water (H ₂ O molecules interacting)				
Plastic material (polyethylene container/spoon)				
Potassium chloride fertilizer				
Ammonium nitrate fertilizer				
Carbon dioxide gas				

LEARNING ACTIVITY SHEET

Lesson Exemplar	15	Date	
Lesson Title/Topic:	Chemical Bonding and Compounds/Naming and Writing Compounds Using IUPAC Nomenclature		
Name		Grade & Section	

I. LEARNING OBJECTIVES

1. Name and write the formula of ionic compounds formed by representative metals and nonmetals using IUPAC nomenclature.
2. Name and write the formula of covalent compounds formed by representative nonmetals using IUPAC nomenclature.

II. MATERIALS

- Periodic table of elements
- Pen or pencil
- Notebook or answer sheet

III. INTRODUCTION

The International Union of Pure and Applied Chemistry (IUPAC) nomenclature system was developed to create a universal and standardized method for naming chemical compounds. Before its establishment, scientists from different countries often used different names for the same substance, leading to confusion in scientific communication. The International Union of Pure and Applied Chemistry was founded in 1919 and became responsible for organizing consistent naming rules that chemists around the world could follow. Through the years, the system evolved to include rules for naming ionic compounds, covalent compounds, acids, organic compounds, and many other chemical substances. Today, IUPAC nomenclature is widely used in chemistry education, research, medicine, and industry because it ensures clarity, accuracy, and international understanding.

Source: International Union of Pure and Applied Chemistry, Nomenclature of Inorganic Chemistry: IUPAC Recommendations 2005 (Cambridge: Royal Society of Chemistry Publishing, 2005).

IV: ACTIVITY PROPER

PART I: COMMON RULES IN IUPAC NOMENCLATURE

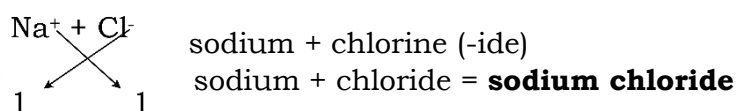
A. IONIC COMPOUNDS

I. Binary Ionic Compounds (*Metal + Nonmetal*)

Naming Rules

1. Name the metal (cation) first.
2. Name the nonmetal (anion) second.
3. Change the ending of the nonmetal to “-ide.”
4. Do NOT use prefixes such as mono-, di-, tri-, etc.
5. Balance charges so the total positive charge equals the total negative charge using the criss-cross method.

Example:



Sodium has a +1 charge while chloride has a -1 charge. Criss-cross the charges to obtain the correct subscripts.

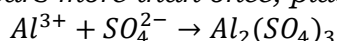
II. Ternary Ionic Compounds (*Metal or NH₄⁺ + Polyatomic Ion*)

Naming Rules

1. Name the metal or ammonium ion first.
2. Name the polyatomic ion second.
3. Do NOT change the ending of polyatomic ions.
4. Balance charges so the total positive charge equals the total negative charge using the criss-cross method.

Important Reminder!

If a polyatomic ion appears more than once, place it inside parentheses.



Examples:

- $\text{CaCO}_3 \rightarrow$ calcium carbonate
- $\text{NaNO}_3 \rightarrow$ sodium nitrate
- $\text{KOH} \rightarrow$ potassium hydroxide
- $(\text{NH}_4)_2\text{SO}_4 \rightarrow$ ammonium sulfate

III. Ionic Compounds with Transition Metals (*Stock System*)

Naming Rules

1. Name the transition metal first.
2. Write the metal charge in Roman numerals inside parentheses.
3. Name the anion second.
4. Use:
 - “-ide” for single-element anions
 - unchanged names for polyatomic ions
5. Balance charges so the total positive charge equals the total negative charge using the criss-cross method.

Determining Metal Charge Tip!



Each chloride ion has a -1 charge. Since there are 3 chloride ions, the total negative charge is -3. Therefore, iron must have a +3 charge. The compound is named iron(III) chloride.

Examples:

- $\text{FeCl}_2 \rightarrow$ iron(II) chloride
- $\text{FeCl}_3 \rightarrow$ iron(III) chloride
- $\text{Fe}_2(\text{SO}_4)_3 \rightarrow$ iron(III) sulfate
- $\text{CuO} \rightarrow$ copper(II) oxide

B. COVALENT COMPOUNDS

I. Molecular (Covalent) Compounds (Nonmetal + Nonmetal)

Naming Rules

1. Use prefixes to show the number of atoms.
2. The first element keeps its name.
3. Omit “mono-” for the first element.
4. The second element:
 - always uses a prefix
 - changes ending to “-ide”

List of common prefixes:

1 = mono- 2 = di- 3 = tri- 4 = tetra- 5 = penta- 6 = hexa-

Examples:

- $\text{CO}_2 \rightarrow$ carbon dioxide
- $\text{N}_2\text{O}_5 \rightarrow$ dinitrogen pentoxide

II. Naming Acids

A. Binary Acids (H + nonmetal)

Naming Rules

1. Add the prefix “hydro-”
2. Use the root name of the nonmetal
3. Change ending to “-ic”
4. Add the word acid

Examples:

- $\text{HCl(aq)} \rightarrow$ hydrochloric acid
- $\text{HBr} \rightarrow$ hydrobromic acid

B. Oxyacids (Acids containing oxygen)

Naming Rules

1. If the polyatomic ion ends in “-ate”, change it to “-ic acid.”
2. If the polyatomic ion ends in “-ite”, change it to “-ous acid.”

Examples:

- H_2SO_4 (sulfate) $\rightarrow$ sulfuric acid
- H_2SO_3 (sulfite) $\rightarrow$ sulfurous acid

NOW TRY THIS!

SET A: NAMING COMPOUNDS

Write the correct IUPAC name for each compound.

1. NaCl
2. CaCO_3
3. FeCl_3
4. Cu_2O
5. $\text{Al(NO}_3)_3$
6. CO_2
7. N_2O_5
8. SO_3
9. HF
10. H_2SO_4

SET B: WRITING FORMULA

Write the correct chemical formula for each compound.

1. sodium chloride
2. calcium carbonate
3. iron(III) oxide
4. copper(I) oxide
5. ammonium sulfate
6. aluminum nitrate
7. carbon dioxide
8. dinitrogen pentoxide
9. sulfur trioxide
10. hydrochloric acid

ADDITIONAL PRACTICE SET

A. Identify Whether the Compound is Ionic or Covalent

Instructions: Write Ionic or Covalent.

1. MgCl_2 = _____
2. CO = _____
3. Fe_2O_3 = _____
4. PCl_5 = _____
5. NaOH = _____

B. Error Analysis

Instructions: Correct the mistakes in the following names.

1. NaCl → sodium chlorine
Correct Name: _____
2. CO_2 → carbon oxide
Correct Name: _____
3. FeCl_2 → iron chloride
Correct Name: _____
4. $\text{Ca}(\text{NO}_3)_2$ → calcium nitride
Correct Name: _____
5. N_2O_4 → nitrogen oxide
Correct Name: _____

V. SYNTHESIS

Instructions: Answer the following questions briefly.

1. Why are prefixes used in naming covalent compounds but not in ionic compounds?

2. Why is it important to balance charges when writing ionic compound formulas?

3. How do Roman numerals help in naming transition metal compounds?

4. What is the difference between binary acids and oxyacids?

5. In your own words, explain the importance of using IUPAC nomenclature in chemistry.

LEARNING ACTIVITY SHEET (LAS)

Lesson Exemplar	16	Date	
Lesson Title/Topic:	Chemical Bonding and Compounds/Lewis Structure of Ionic and Covalent Compounds		
Name		Grade & Section	

I. LEARNING OBJECTIVES

1. Explain how the Octet Rule governs electron transfer or sharing in chemical bonding, including its common exceptions.
2. Draw the Lewis Structure of ions formed by representative elements.
3. Construct the Lewis Structure of ionic compounds by modeling electron transfer between metals and nonmetals.
4. Construct the Lewis Structure of covalent (molecular) compounds by showing electron sharing between nonmetal atoms.

II. MATERIALS

- Periodic Table of Elements
- “Recipe Card”
- Pen or pencil
- Colored pens or markers (optional for electrons)
- Notebook or answer sheet

III. INTRODUCTION

Chemical bonding can be understood as a process where atoms interact to become more stable. According to the Octet Rule, atoms tend to gain, lose, or share electrons to achieve a stable arrangement of eight valence electrons, similar to noble gases. This rule helps explain why ionic bonds involve electron transfer between metals and nonmetals, while covalent bonds involve sharing electrons between nonmetals.

To standardize the understanding of chemical structures and bonding, modern chemistry relies on systematic rules such as those established by the International Union of Pure and Applied Chemistry (IUPAC), which provides globally accepted guidelines for describing chemical substances and their structures.

In this activity, chemical bonding will be visualized through a “cooking recipe” analogy, where elements act as ingredients, and bonding processes represent cooking steps that produce stable compounds.

Source: Brown, Theodore L., et al. Chemistry: The Central Science. 14th ed. Boston: Pearson, 2018.

IV. PROCEDURES

A. Chemical Recipe Exploration

1. Read the given “chemical recipes,” where atoms are treated as ingredients and bonding is treated as the cooking process.
 - $2\text{Na} + \text{Cl}_2 \rightarrow 2\text{NaCl}$ (table salt recipe)
 - $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$ (water recipe)
 - $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$ (carbon dioxide recipe)

B. Recipe Interpretation

2. For each chemical recipe, identify:
- the elements involved (ingredients)
 - whether electrons are **transferred (ionic bonding)** or **shared (covalent bonding)**
 - how the **Octet Rule** is satisfied in the compound formed

C. Lewis Structure Construction

3. Draw the Lewis Structures for:
- ions of representative elements
 - ionic compounds showing electron transfer from metal to nonmetal
 - covalent compounds showing electron sharing between nonmetals

D. Recipe Card Completion (Annex G)

4. Complete the “Recipe Card” by filling in:

RECIPE CARD	
RECIPE NAME: [Name of Compound]	
INGREDIENTS (Elements Involved): _____ _____	
TYPE OF BONDING (Ionic or Covalent): _____	
DESCRIPTION OF ELECTRON BEHAVIOR: _____ _____ _____	
FINAL COMPOUND FORMED: _____	
LEWIS STRUCTURE DRAWING: 	
STABILITY CHECK BASED ON THE OCTET RULE: _____ _____ _____	

(Source: Google Gemini AI. Generated image for educational purposes. 2026.)

SHORT EXPLANATION

How did the atoms become stable?

V. SYNTHESIS QUESTIONS

Instructions: Answer the following questions to check your understanding.

1. How does the Octet Rule explain why atoms form bonds in the first place?

2. What is the difference between electron transfer and electron sharing?

3. How can you identify if a compound is ionic or covalent based on its Lewis Structure?

4. Why do some atoms not strictly follow the Octet Rule? Give an example.

5. How did the “chemical recipe” model help you understand bonding better compared to traditional lecture learning?

LEARNING ACTIVITY SHEET

Lesson Exemplar No.	17	Date	
Lesson Title/Topic:	Properties of Ionic and Covalent Compounds		
Name		Grade & Section	

Presenting Examples Option 1: Learning Stations

I. Objectives:

At the end of the experiment, learners are expected to:

1. investigate the selected physical properties of common substances through station-based activities;
2. classify substances as ionic or covalent based on solubility, electrical conductivity, and observable properties; and
3. analyze patterns linking bonding type to properties such as solubility, electrical conductivity, and melting points.

II. Materials

Salt (NaCl)	Conductivity tester or simple
Sugar (sucrose)	LED circuit tester
Ethanol	Droppers or small scoops
Distilled water	Observation worksheet
Paraffin wax	Paper towels
Beakers or small cups	Station cards/instructions
Stirring rods or spoons	

III. Procedures

A. Grouping and Rotation

1. The class will be divided into small groups.
2. Each group will rotate through three stations:
 - Station A: Solubility Test
 - Station B: Property Data Analysis
 - Station C: Electrical Conductivity Test

B. Station Activities

Station A: Solubility Test

- Add a small amount of each substance into water.
- Stir and observe whether it dissolves or not.
- Record observations.

Station B: Property Data Analysis

- Study provided data tables/infographics on melting point, boiling point, polarity, and state of matter.
- Compare and match properties with known characteristics of ionic and covalent compounds.

Station C: Electrical Conductivity Test

- Test each substance (or its solution where applicable) using a conductivity tester.
- Observe whether the substance allows electric current to pass.
- Record results.

C. Synthesis

- After completing all stations, groups consolidate their data.
- Classify each substance as ionic or covalent based on evidence.
- Prepare a short group summary for the presentation.

IV. Data Collection

Complete the table below during the activity:

Substance	Solubility in Water	Electrical Conductivity	Other Observations	Bond Type (Ionic/Covalent)
Salt				
Sugar				
Ethanol				
Distilled Water				
Paraffin Wax				

V. Guide Questions

1. Which substances dissolved in water? Which did not?
2. Which substances conduct electricity, and why?
3. What patterns did you observe between solubility and bonding type?
4. How does electrical conductivity help distinguish ionic from covalent substances?
5. Why do ionic compounds generally behave differently from covalent compounds in water?
6. How can these properties help you identify unknown substances in real life?
7. What relationship can you infer between chemical bonding and observable physical properties?

VI. Conclusion

Share your significant insights from the experiment's learning stations in relation to the properties of ionic and covalent compounds.

Option 2: Virtual PhET simulation

Exploring Ionic and Covalent Compounds through Simulation Virtual Learning Activity (PhET Simulation-Based Exploration)

I. Objectives

At the end of the activity, learners should be able to:

1. explore the properties of ionic and covalent compounds using a virtual simulation platform;
2. compare the behavior of salt and sugar in terms of solubility, melting point, and electrical conductivity; and
3. differentiate ionic and covalent compounds based on simulation evidence.

II. Materials

- Laptop, desktop, or mobile device
- Internet connection
- PhET Simulation link: <https://bit.ly/3Rjn8wY>
- Headphones (optional)
- Learning Activity Sheet / notebook
- Pen or digital note-taking tool

III. Procedures

A. Access the Simulation

1. Launch the PhET simulation on ionic and covalent compounds.
2. Familiarize yourself with the interface and available controls.

B. Exploration Phase

1. Select and observe salt (ionic compound) in different conditions.
2. Select and observe sugar (covalent compound) under the same conditions.
3. Manipulate simulation settings related to:
 - Solubility in water
 - Heating (melting point behavior)
 - Electrical conductivity

C. Investigation Phase

1. Compare how salt and sugar behave in each condition.
2. Take note of particle interactions shown in the simulation.
3. Record observations in the data table provided.

D. Analysis and Discussion

1. Answer the guide questions based on your observations.
2. Prepare a short explanation of your findings based on simulation evidence.

IV. Data Collection

Property	Salt (Ionic Compound)	Sugar (Covalent Compound)	Observations
Solubility in Water			
Melting Behavior			
Electrical Conductivity			
Particle Interaction			

V. Guide Questions

1. What differences did you observe between salt and sugar in the simulation?
2. How does the simulation explain the solubility, melting points, and conductivity of salt and sugar?
3. How does the simulation show the difference between ionic and covalent compounds?

VI. Conclusion

What have you learned from this activity in relation to the properties of ionic and covalent compounds?

Option 3: Creating a Comic Strip

Directions:

Using a 4–6 panel comic strip template, illustrate the properties of ionic and covalent compounds.

Option 4: Classifying Compounds

Directions:

Given the following compounds with corresponding properties, classify them whether they are ionic or covalent compounds and provide justification based on the identified properties.

Substance/ Properties	Bond Type	Reason
A. Carbon dioxide (CO₂) <ul style="list-style-type: none">• Gas at room temperature• Does not conduct electricity• Low boiling point		
B. Calcium carbonate (CaCO₃) <ul style="list-style-type: none">• Solid (chalk-like)• High melting point• Does not conduct electricity in solid form.		
C. Methane (CH₄) <ul style="list-style-type: none">• Gas at room temperature• Non-conductive• Very low melting and boiling point		
D. Potassium iodide (KI) <ul style="list-style-type: none">• Crystalline solid• Dissolves in water• Conducts electricity in solution		

Directions:

Choose the letter of the best answer and write it on a separate sheet of paper.

1. Which property is most characteristic of ionic compounds?
 - A. low melting point but high solubility
 - B. poor solubility in water even in powdered form
 - C. waxy texture, high melting point and soluble in water
 - D. strong ability to conduct electricity when dissolved in water
2. Which phrase describes a substance that is most likely a covalent compound?
 - A. dissolves in water and conducts electricity
 - B. forms crystals and has a high melting point
 - C. has a low melting point and does not conduct electricity
 - D. is hard and brittle because it cannot be dissolved in water
3. Why do many ionic compounds conduct electricity when dissolved in water?
 - A. Their molecules break into atoms.
 - B. They form free-moving ions in solution.
 - C. Water becomes electrically charged at some point.
 - D. They melt in water and become electrically charged particles.
4. Which of the following properties would you expect from most covalent compounds?
 - A. low melting point
 - B. high boiling point
 - C. conductivity in solid form
 - D. hard and brittle structure
5. An unknown substance has a high melting point, and dissolves in water. What is it most likely?
 - A. Ionic compound
 - B. Covalent compound
 - C. Can be both ionic and covalent
 - D. Neither ionic nor covalent compounds

LEARNING ACTIVITY SHEET

Lesson Exemplar	18	Date	
Lesson Title/Topic:	Predicting Bond Type Using Electronegativity Difference		
Name		Grade & Section	

B.1. Presenting Examples

Option 1: Predicting Bond Type Using Electronegativity Difference

I. Objectives

At the end of the activity, learners should be able to:

1. use the periodic table to determine electronegativity values of elements;
2. compute electronegativity differences for given compounds;
3. classify bonds as ionic, polar covalent, or nonpolar covalent based on electronegativity difference; and
4. explain the relationship between electronegativity difference and bond character.

II. Materials

- Periodic table (printed or digital)
- Learning Activity Sheet / notebook
- Pen or pencil
- Calculator (optional)

III. Procedures

A. Grouping and Assignment

1. The class will be divided into three groups.
2. Each group will analyze a specific set of compounds:
 - Group 1: Chlorine compounds (Cl_2 , NaCl , HCl)
 - Group 2: Oxygen compounds (O_2 , H_2O , MgO)
 - Group 3: Fluorine compounds (F_2 , HF , LiF)

B. Electronegativity Analysis

1. Using the periodic table, identify the electronegativity values of each element in the compounds.
2. Compute the electronegativity difference (ΔEN) for each compound:
$$\Delta\text{EN} = | \text{EN}_1 - \text{EN}_2 |$$

3. Record the computed values in the table provided.

C. Bond Classification

1. Based on electronegativity difference, classify each bond as:
 - Nonpolar covalent
 - Polar covalent
 - Ionic
2. Justify classification using numerical evidence.

D. Group Discussion

1. Compare results within the group.
2. Prepare a short explanation of the observed patterns.
3. Share findings with the class.

IV. Data Collection

Compound	EN of Element 1	EN of Element 2	Δ EN	Bond Type (Nonpolar Covalent / Polar Covalent / Ionic)
Cl ₂				
NaCl				
HCl				
O ₂				
H ₂ O				
MgO				
F ₂				
HF				
LiF				

V. Guide Questions

1. What relationship do you observe between electronegativity difference and bond character?
2. How does increasing electronegativity difference influence whether a bond becomes ionic or covalent?
3. Which compounds showed the highest electronegativity difference? What type of bonding did they form?

VI. Conclusion

How does electronegativity difference relate to bond character?

Option 2: Virtual PhET simulation
Topic: Molecular Polarity and Electronegativity

I. Objectives

At the end of the activity, learners should be able to:

1. Explore molecular polarity using a virtual simulation (PhET Molecule Polarity).
2. Explain how electronegativity differences affect electron distribution in molecules.
3. Distinguish between polar and nonpolar molecules based on structure and shape.

II. Materials

- Device (laptop, desktop, or mobile phone)
- Internet connection
- Simulation link: <https://bit.ly/4v056hw>
- Learning Activity Sheet / notebook
- Pen or digital note-taking tool
- Headphones (optional)

III. Procedures

A. Access the Simulation

1. Launch the PhET Molecule Polarity simulation.
2. Explore the interface, including atom selection, electronegativity settings, and molecular shapes.

B. Exploration Phase

1. Construct different molecules using the simulation tools.
2. Observe how changing atoms affects electron distribution.
3. Adjust electronegativity differences between atoms.
4. Examine how molecular shape changes polarity outcomes.

C. Investigation Phase

1. Identify whether each molecule formed is polar or nonpolar.
2. Observe electron density shifts and dipole formation.
3. Record your observations for each molecule tested.

D. Analysis Phase

1. Answer the guide questions based on simulation evidence.
2. Discuss patterns observed in electronegativity and molecular shape.
3. Prepare a short group or individual explanation.

IV. Data Collection

<i>Molecule Tested</i>	<i>Electronegativity Difference</i>	<i>Electron Distribution</i>	<i>Polarity (Polar/Nonpolar)</i>
Molecule 1			
Molecule 2			
Molecule 3			
Molecule 4			

V. Guide Questions

1. How does changing the atoms in a molecule affect the distribution of electrons and the overall polarity of the molecule?
2. What patterns do you observe between electronegativity differences and the shape or polarity (polar or nonpolar) of molecules in the simulation?
3. Why do some molecules with polar bonds become nonpolar overall?

VI. Conclusion

Share your most significant learnings from this virtual activity.

MULTIPLE CHOICE SHORT QUIZ

Directions:

Choose the letter of the best answer and write it on a separate sheet of paper.

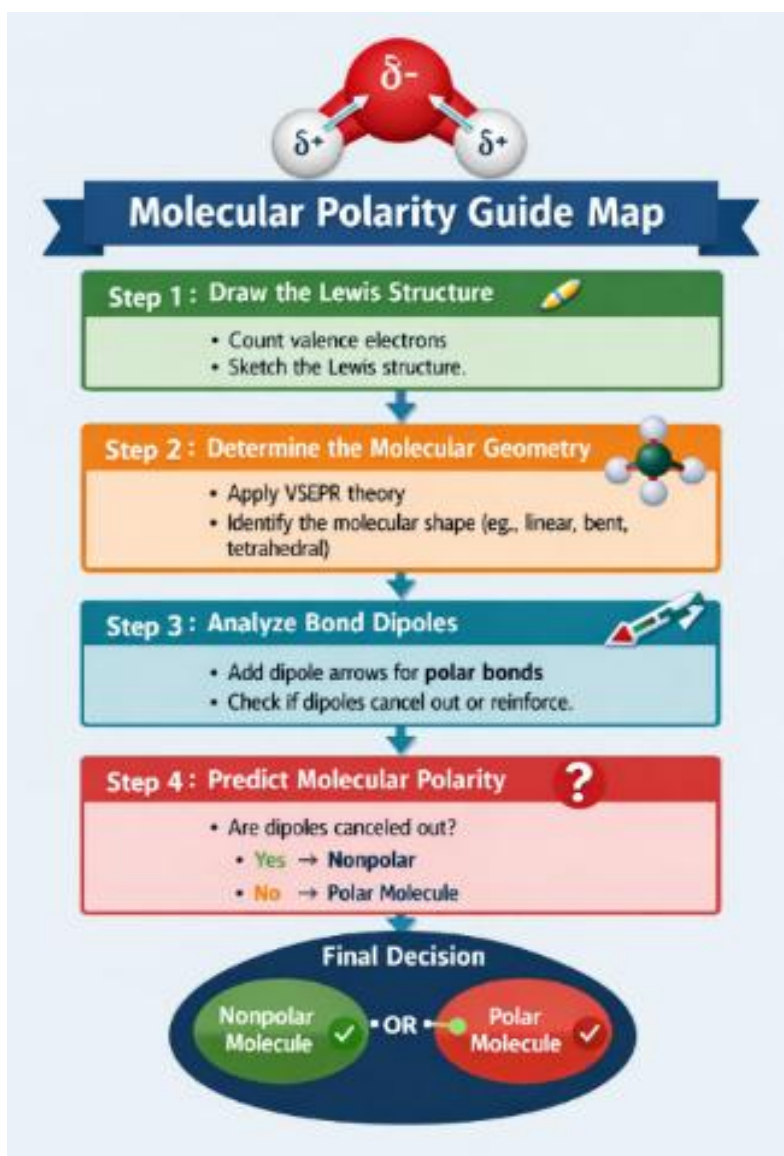
1. A molecule has polar bonds, but it is classified as nonpolar overall. Which statement best explains this?
 - A. The molecule contains only nonmetal atoms.
 - B. The electronegativity difference is always zero.
 - C. The molecular shape causes dipoles to be canceled out.
 - D. The molecule does not contain any covalent bonds.
2. Which pair best contrasts a polar covalent bond and an ionic compound?

A. O_2 and N_2	B. NaCl and HCl
C. CH_4 and CO_2	D. H_2O and CO_2
3. A student claims that all compounds with polar bonds are automatically polar molecules. Which observation best refutes this claim?
 - A. CO_2 is nonpolar even though it has polar C=O bonds
 - B. H_2 always forms nonpolar bonds
 - C. CH_4 has four hydrogen atoms
 - D. NaCl dissolves in water
4. Which situation correctly explains why water (H_2O) is polar while carbon dioxide (CO_2) is nonpolar?
 - A. CO_2 has stronger bonds than H_2O
 - B. H_2O has no electronegativity difference
 - C. H_2O has a bent shape, while CO_2 is linear
 - D. CO_2 contains ionic bonds, while H_2O contains covalent bonds
5. A molecule contains polar bonds, but its bond dipoles cancel because of symmetry. What is the best description of the molecule?
 - A. Ionic
 - B. Metallic
 - C. Overall nonpolar
 - D. Always water-soluble

LEARNING ACTIVITY SHEET

Lesson Exemplar	19	Date	
Lesson Title/Topic:	Molecular Polarity based on bond polarity, VSEPR and Molecular Geometry		
Name		Grade & Section	

- I. **Activity No. 1: Guided Prediction Activity: Tracing Polarity Pathways**
- II. **Objective(s):** At the end of the activity, you should be able to predict polarity of a molecule based on VSEPR Theory and Molecular Geometry.
- III. **Materials Needed:** pen and paper, Periodic Table of Elements, Molecular Polarity Guide Map
- IV. **Instructions:**
Part A. Review the Guide Map



Step	What to Do	Key Question to Ponder
1	Draw the Lewis structure.	How many valence electrons does each atom contribute?
2	Determine Molecular Geometry	What is the molecular shape according to VSEPR theory?
3	Analyze Bond Dipoles	Do the dipole arrows cancel or reinforce each other?
4	Predict Molecular Polarity	Is the molecule polar or nonpolar?

Quick Reference: Common Molecular Geometries:

Electron Domains	Bonding Pairs	Lone Pairs	Shape	Example
2	2	0	Linear	BeCl ₂
3	3	0	Trigonal Planar	BF ₃
3	2	1	Bent	SO ₂
4	4	0	Tetrahedral	CCl ₄
4	3	1	Trigonal Pyramidal	PCl ₃
4	2	2	Bent	H ₂ S
5	5	0	Trigonal Bipyramidal	PCl ₅
6	6	0	Octahedral	SF ₆

Part B. Analyze the following molecules using the four-step guide map. Complete the table for each molecule.

Steps	H ₂ O	CO ₂	NH ₃	CH ₄
Step 1: Lewis Structure				
Total Valence e ⁻				
Sketch				
Step 2: Molecular Geometry				
Electron Domains				
Bonding Pairs				
Lone Pairs				
Shape:				

Step 3: Bond Dipoles				
Dipole direction: toward _____.				
Cancel? Yes/No				
Why?				
Step 4. Prediction				
Polar or non-polar?				

V. Synthesis:

1. How did you arrive at your answers? *Describe the step-by-step process you used to predict polarity.*

2. How did you find the activity? Can you share and describe your experience? What did you find challenging? Which step was the easiest or hardest for you?

LEARNING ACTIVITY SHEET

Lesson Exemplar No.	20	Date	
Lesson Title/Topic:	Differentiating Intramolecular and Intermolecular Forces Using Diagram		
Name		Grade & Section	

I. Activity No. 1: Diagram Representation

II. Objective(s): At the end of the activity, you should be able to:

- Represent through diagrams the difference between intramolecular forces and intermolecular forces;
- Differentiate the two types of forces by analyzing diagrams focusing on relative strength and location.
- Use the diagram-based distinction between the two forces to explain selected physical properties such as melting point, boiling point, and solubility.

III. Materials Needed: pen and paper, Diagram Convention Chart, colored pen/pencils (*optional*)

IV. Instructions:

Part A. Review the Diagram Convention Chart

Convention	Meaning	Used for	Visual Example
Solid line	Strong force, within structural unit	Intramolecular force	O—H, Na ⁺ —Cl ⁻ , C—C
Dashed line (- - -)	Moderate force, between structural unit	Intermolecular forces (dipole-dipole)	H—O···H—O (H-bond)
Dotted Line (...)	Weak force, between structural units	Intermolecular forces (London Dispersion)	Cl ₂ ····Cl ₂
Line Thickness	Relative Strength	Thicker = stronger	Ionic bond (thick) vs. H-bond (thin dashed)
Numerical label	Approximate/illustrative energy value	Both types	Covalent: ~400 kJ/mol; H-bond: ~20 kJ/mol
Distance between units	Inverse relationship with strength	Both Types	Closer = stronger attraction

Note: This convention is for this lesson purpose alone. Some references may be used in other conventions.

Part B. Draw each scenario below using the correct conventions. Label all forces with line style, thickness, energy value, and distance. Then answer the analysis questions for each.

Worktable: Diagramming Scenarios

	Scenario 1: Two Water Molecules	Scenario 2: Solid Iodine (I₂)	Scenario 3: HCl molecules
Your Diagram	Draw here:	Draw here:	Draw here:
Forces Present			
Intramolecular (within)	Type: _____ Line: _____ Energy: _____	Type: _____ Line: _____ Energy: _____	Type: _____ Line: _____ Energy: _____
Intermolecular (between)	Type: _____ Line: _____ Energy: _____	Type: _____ Line: _____ Energy: _____	Type: _____ Line: _____ Energy: _____
Relative Distance	Covalent: ____ Å H-bond: ____ Å	I—I bond: ____ Å I ₂ ⋯I ₂ : ____ Å	H—Cl bond: ____ Å HCl⋯HCl: ____ Å

Analysis Question for Each Scenario

Scenario 1: Two Water Molecules

- a) Location: Where exactly are the covalent bonds located? Where are the hydrogen bonds located?

- b) Strength comparison: How much stronger is the O—H covalent bond than the hydrogen bond? Use the numerical labels to explain.

- c) Effect on properties: How do hydrogen bonds explain why water has a high boiling point compared to similar-sized molecules?

Scenario 2: Solid Iodine (I_2)

- a) Location: What force exists within each I_2 molecule? What force exists between different I_2 molecules in the solid?

- b) Strength comparison: Why does solid iodine sublime easily (go directly from solid to gas) even though the I—I covalent bond is strong?

- c) Effect on properties: What would happen to the melting point of iodine if the intermolecular forces were stronger?

Scenario 3: Sodium Chloride in Water

- a) Location: Describe the ionic bond in the NaCl lattice. Then describe what happens at the molecular level when NaCl dissolves in water.

b) Strength comparison: Explain why NaCl dissolves in water by considering disruption of the ionic lattice and hydration of Na⁺ and Cl⁻ ions by water molecules.

c) Effect on properties: Why does NaCl dissolve in water much more readily than in nonpolar oil? Explain using polarity and the relative strengths of solute-solute, solvent-solvent, and solute-solvent interactions.

V. Synthesis:

1. How did you arrive at your answers? *Describe how you decided which convention to use for each force. What was your reasoning process for distinguishing within vs. between?*

2. How did you find the activity? Can you share and describe your experience? What was more challenging: drawing the conventions correctly or explaining the forces? Did the guide questions help? What would you improve?

LEARNING ACTIVITY SHEET

Lesson Exemplar	21	Date	
Lesson Title/Topic:	Types of Intermolecular Forces		
Name		Grade & Section	

I. Activity No. 1: Force Detective Card Sort

II. Objective(s): At the end of the activity, you should be able to identify the type of intermolecular force in each molecular scenario.

III. Materials Needed: pen and paper, Periodic table of elements (for electronegativity value)

IV. Instructions:

Part A. Review the summary below.

Force Type	Relative Strength	Requirements	Key Examples
London Dispersion Forces (LDF)	Weak (~1–10 kJ/mol)	Present in all molecules; only force in nonpolar molecules	Ne—Ne, Cl ₂ ····Cl ₂ , CH ₄ ····CH ₄
Dipole-Dipole Forces	Moderate (~10–40 kJ/mol)	Permanent dipole in polar molecules; NO H bonded to N, O, or F	HCl····HCl, CO····CO
Hydrogen Bonding	For comparable small molecules, hydrogen bonding is generally stronger than ordinary dipole-dipole interactions. However, London dispersion forces can become substantial in larger, more polarizable molecules.	H must be directly bonded to N, O, or F	H ₂ O····H ₂ O, HF····HF, NH ₃ ····NH ₃

*Critical Rule: Hydrogen bonding is NOT just any bond involving hydrogen. The hydrogen must be covalently bonded to **N, O, or F** — highly electronegative atoms commonly associated with hydrogen bonding. H bonded to Cl, S, C, etc. does **NOT** form hydrogen bonds, even if the molecule is polar.*

Part B. Examine each molecule. Classify the dominant intermolecular force and justify your answer.

Card	Molecule / Diagram	Force Type	Justification
1	Ne—Ne		
2	H—F⋯H—F		
3	Cl—Cl⋯Cl—Cl		
4	H—Cl⋯H—Cl		
5	H—O—H⋯O—H ₂		
6	CH ₄ ⋯CH ₄		
7	H—N—H⋯N—H ₃		
8	CO ₂ ⋯CO ₂		
9	CH ₃ OH⋯HOCH ₃		
10	Br—Br⋯Br—Br		
11	H—Br⋯H—Br		
12	CH ₃ Cl⋯CH ₃ Cl		
13	H—C≡N⋯N≡C—H		
14	C ₂ H ₅ OH⋯HOC ₂ H ₅		
15	O ₂ ⋯O ₂		

Spot Analysis

Card 4: $\text{H}-\text{Cl}\cdots\text{H}-\text{Cl}$

a) Why is this NOT hydrogen bonding? Use the critical rules to explain.

b) What force IS present, and why?

c) What would need to change in the molecule for hydrogen bonding to occur?

Card 11: $\text{H}-\text{Br}\cdots\text{H}-\text{Br}$

a) Is HBr capable of hydrogen bonding? Why or why not?

b) Compare HBr to HF. Why does HF have hydrogen bonding but HBr does not?

V. Synthesis:

1. How did you arrive at your answers? *Describe your step-by-step process for classifying each card.*

2. How did you find the activity? Can you share and describe your experience? What cards tricked you first? How did you correct your mistakes? Did the critical rule for hydrogen bonding surprise you?

LEARNING ACTIVITY SHEET

Lesson Exemplar	22	Date	
Lesson Title/Topic:	Intermolecular Forces and Properties of Substances		
Name		Grade & Section	

I. Activity No. 1: Matching & Explanation – Intermolecular Forces in Action

II. Objective(s):

By the end of this activity, learners will be able to:

- Identify and match everyday scenarios with the correct liquid property influenced by intermolecular forces (IMFs).
- Explain how IMFs affect physical properties such as surface tension, vapor pressure, boiling point, and melting point.
- Apply scientific reasoning using scaffolded sentence starters to produce clear and accurate explanations.

III. Materials Needed:

Notebook or activity sheet
 Pen/pencil
 Whiteboard/marker for group synthesis

IV. Instructions:

Part A. Match each property in Column A with the correct everyday scenario in Column B. Then, complete the explanation using the sentence starter provided:

“This happens because intermolecular forces...”

Column A – Liquid Properties
1. Surface Tension
2. Vapor Pressure
3. Boiling Point
4. Melting Point

Column B – Everyday Scenarios
A. Water striders walk on water
B. Perfume spreads quickly in air
C. Cooking pasta in boiling water vs. frying in oil
D. Salt lowers ice’s melting point on roads

Part B. Write the letter of the correct scenario beside each property.

- Complete the explanation using the scaffold provided.

Property	Scenario	Explanation
Surface Tension		
Vapor Pressure		
Boiling Point		
Melting Point		

V. Synthesis:

1. What misconceptions about IMFs or liquid properties did you initially have before completing the matching task?

2. Which everyday scenario best helped you understand the role of IMFs? Why?

3. How can understanding IMFs and their effects on properties be applied to real-world contexts (e.g., cooking, materials science, environmental sustainability)?

LEARNING ACTIVITY SHEET

Lesson Exemplar No.	23	Date	
Lesson Title/Topic:	Intermolecular Forces and Properties of Substances		
Name		Grade & Section	

I. Activity No. 1: Laboratory Investigation: Liquid Face-Off

II. Objective(s):

By the end of this activity, learners will be able to:

- Observe and record the physical properties of water, ethanol, and glycerin through surface tension and viscosity tests.
- Compare and analyze the results of the Penny Test, Paper Clip Test, and Speed Test to determine differences in intermolecular force (IMF) strength among the liquids.
- Compare the liquids using the surface-tension and viscosity evidence. Explain how intermolecular attractions may contribute to the observed differences while also considering molecular size, shape, composition, and temperature.

III. Materials Needed:

- 3 small beakers or cups (labeled: Water, Ethanol, Glycerin)
- 3 Medicine droppers
- 3 One-peso coins (cleaned and dried)
- 3 Metal paper clips
- 1 Plastic tray or glass sheet (for the tilt test)
- Stopwatch

IV. Instructions:

Test 1: The Penny Test (Surface Tension)

1. Place a clean 1-peso coin flat on the table.
2. Using a dropper, add **Water** drop by drop onto the center of the coin. Count how many drops it takes before the water spills over the edge.
3. Record the count and observe the shape of the "dome."
4. Dry the coin and repeat the process for **Ethanol** and **Glycerin**.
 - Science Note: Under the same test conditions, more drops on the coin indicate higher surface tension. Interpret this as evidence related to intermolecular attractions, not as a direct measurement of a single intermolecular-force strength.

Test 2: The Paper Clip Test (Surface Tension)

1. Fill a small beaker with **Water**.
2. Carefully try to float a paper clip horizontally on the surface of the water (Tip: Use a bent paper clip as a cradle to lower it gently).
3. Record if the paper clip floats or sinks immediately.
4. Repeat for the other two liquids.
 - Science Note: Stronger IMFs create a "skin" that can support the weight of the clip.

Test 3: The Speed Test (Viscosity)

1. Place three large drops of each liquid in a row at the top of a tilted plastic tray.
2. Release them at the same time and start the stopwatch.
3. Time how long it takes each liquid to travel 10 centimeters.

- Record the time in seconds.

Science Note: Slower flow indicates higher viscosity under the test conditions. Viscosity is influenced by intermolecular attractions as well as molecular size, shape, composition, and temperature.

IV. Data Table:

Liquid	Penny Test (No. of Drops)	Paper Clip (Float/Sink)	Speed Test (Time in Sec)
Water			
Ethanol			
Glycerin			

V. Analysis & Ranking Task:

Using your data, compare the liquids in terms of surface tension and viscosity. Then explain how intermolecular attractions and molecular structure may contribute to the observed differences.

- Strongest:** _____ (Reason: High drops, Floated clip, Slower flow)
- Middle:** _____
- Weakest:** _____ (Reason: Fewest drops; Sank clip; Fastest flow)

VI. Synthesis:

- What did you discover about the relationship between intermolecular forces (IMFs) and physical properties such as surface tension and viscosity?

- Which test (Penny Test, Paper Clip Test, or Speed Test) gave you the clearest evidence of IMF strength? Why?

- What misconceptions about IMFs or liquid properties were clarified through this activity?

LEARNING ACTIVITY SHEET

Lesson Exemplar No.	24	Date	
Lesson Title/Topic:	Intermolecular Forces and Properties of Substances		
Name		Grade & Section	

I. Activity No. 1: Error Analysis Task

Student Instructions:

II. Objective(s):

By the end of this activity, learners will be able to:

- Identify and correct misconceptions about chemical bonding, molecular polarity, and IMFs.
- Explain how these concepts affect physical properties such as solubility, evaporation, viscosity, and hydrogen bonding.
- Strengthen critical thinking and collaborative discussion skills.

III. Materials Needed:

Notebook or activity sheet

Pen/pencil

Teacher-provided sample statements (misconceptions)

Whiteboard/marker for group synthesis

IV. Instructions:

Part A. Review the following sample statements:

- “Hexane dissolves in water because both are liquids.”
- “Water evaporates faster than ethanol because it is lighter.”
- “All molecules with oxygen are polar.”
- “Viscosity depends only on molecular size.”
- “Gasoline has strong hydrogen bonding because it burns easily.”

Part B. For each statement:

Identify the error.	
Correct it using bonding, polarity, and IMF concepts.	
Explanation	

Part C. Share your corrections with your group and discuss differences in reasoning.

V. Synthesis:

1. What misconceptions did you initially believe?

2. How did group discussion help refine your understanding?

3. How can these concepts be applied to product design and sustainability?
